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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

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No. 1] [1918

I.—PINUS CANARIENSIS.

J. Hutchinson.

(With Plates.)

In the *Bulletin de la Société nationale d'Acclimatation de France* for August, 1917, Dr. G. V. Perez, the veteran botanist of the Canary Islands, and an esteemed contributor and correspondent of Kew, calls attention to the merits of the native pine, *Pinus canariensis*, C. Sm., as a timber tree. Dr. Perez predicts a great future for this species in the reafforestation of those countries bordering the Mediterranean, where the forests are being rapidly denuded for war purposes, and considers it to be the most suitable tree for much of the North African Coast from Morocco to Egypt. He comments on British wisdom in planting the tree extensively in South Africa, where it succeeds admirably,*and in Australia and New Zealand where it is being tried.†

In such regions it is recommended as being invaluable for railway sleepers, mining, and all kinds of construction, its durability when exposed to inclement conditions being phenomenal. As evidence of this may be mentioned the perfect preservation of the ancient native wine presses of Tenerife (there is one in the wood museum at Kew), which are made of the Tea or heart wood of *Pinus canariensis*, and are reputed to be more than two hundred years old. The weight of a cubic foot of the heart wood is given as 68 lbs. 3 oz. (*Kew Bull.* 1915, 266). These wine presses are made of large massive beams which could only have been procured from very big trees, few of which now remain. Some of these giants had trunks measuring as much as 6 ft. 6 in. in diameter, truly colossal proportions compared with the size of the majority of the trees in the islands at the present time. Above the village of Vilaflor, to the south of the Peak of Tenerife, there still exists a group of these giants at an altitude of about 7400 ft. One of these, according to Dr. Perez, is about 160 ft. high, and 36 ft. in circumference! The trees of the forests now clothing the

* cf. Cape of Good Hope. Reports on Forests.

† The species apparently grows well in Cyprus and may be found a suitable tree for planting in the Island.

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slopes of the Canaries are rarely more than half this size. The native pine wood was also used extensively for the construction of the balconies of the older houses, and all are in an excellent state of preservation and frequently most elaborately carved.

Dr. Perez refers to a paper (not seen by us) on *Pinus canariensis* by F. Albert, the chief of the Forestry Department of Chile, where the tree is being experimented with and where it is growing extremely well. Mr. Albert has studied the climate of North Africa, and gives preference to *Pinus canariensis* for the coast land, up to an altitude of 4600 ft., from Egypt to Morocco. The average annual growth of the trees exceeds $3\frac{1}{4}$ ft. and $\frac{1}{3}$ in. in diameter, so that in 20 years they would be anything from 60-90 ft. high, with a diameter of 8-10 in. The trees are best planted about 4 ft. apart, or in very dry places a little over 3 ft., for this species, like *Pinus longifolia*, gives a considerable amount of ground shade.

A good feature of the tree is that it possesses a straight trunk even when grown singly; and in South Africa* it has been demonstrated at Fort Cunynghame that it recovers from damage by fire in a most striking manner, due probably to its thick heavy bark. Dr. Perez records fine examples of the species in Central France, and at La Mortola, in Italy, where there is a specimen 70 ft. high and $7\frac{1}{2}$ ft. in circumference. Mueller† says that the tree thrives well in Victoria, showing celerity of growth, and enduring an occasional shade temperature of 118° F. He recommends the species for the lower mountain regions of Victoria, which are subjected to moderate but never lengthened frosts.

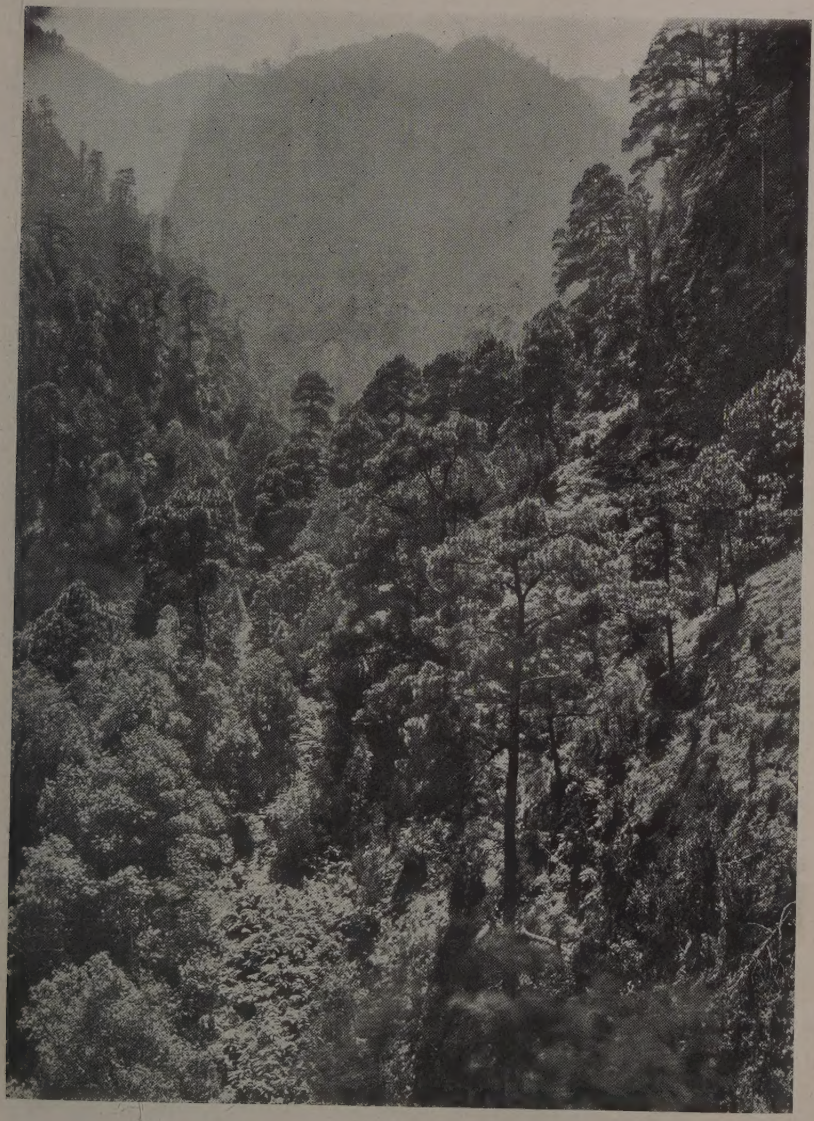
According to correspondence from Mr. D. E. Hutchins, formerly forest officer in South and British East Africa, exotic pine trees have so far failed to succeed in the British East African Protectorate, due possibly to the rich humus soil and a deficiency of mycorrhiza, for according to Stahl‡ Conifers cannot thrive under such conditions. Stahl's explanation is that in humus there is so much competition for the nutritive salts that plants with slow transpiration, such as Conifers, are unable to absorb sufficient food without the co-operation of certain fungi as mycorrhiza. In volcanic and sandy soils where there is less competition the same kind of plants can obtain the necessary food material by means of their own roots and without the aid of other organisms. Mr. Hutchins considers *P. canariensis* a suitable tree for growing in the East African highlands.

In selecting sites for the planting of *Pinus canariensis*, the natural habitat of the species is worth consideration. We understand from Dr. Perez's article that Mr. Hutchins has recently visited Tenerife for this purpose. The tree is most abundant in the Western Canaries, i.e., in the islands of La Palma, Tenerife, Grand Canary, Gomera and Hierro, where the winter rainfall is considerable and the soil is volcanic. It is

* Union of South Africa, Forestry Report, 1912, p. 18.

† F. von Mueller, Suggestions for the Maintenance, Creation, and Enrichment of Forests, 15.

‡ E. Stahl in Pringsh. Jahrb. xxxiv. 607 (1900).



I.

PINUS CANARIENSIS IN THE BARRANCO DEL RIO.

[*To face page* 2.

II.

PINUS CANARIENSIS ON BASALTIC PINNACLES.

To face page 3.]

entirely absent from the two eastern islands, Fuerteventura and Lanzarote, whose climate and vegetation approximate very closely to that of the neighbouring African coast, and where the rainfall is only about 5 in. The Pine forest near the coast in the western islands has been cut down so severely that it is rarely found below 2500 ft., and much of it only commences about 4000 ft. Thence it is found in considerable abundance up to 8000 ft., where the specimens become very dwarf and stunted. In this area it frequently entirely covers the slopes and ridges of the narrow gorges (barrancos), often being found amongst the hard rocks where there is scarcely a particle of soil, but where it can send its roots down amongst the crevices.

The species is confined to the Canary Islands, where it is the chief constituent of the arboreal vegetation, mostly forming pure forest. Being the dominant tree of the archipelago its absence from Madeira and the Azores, with similar climates, and sharing much of the indigenous flora, especially trees and shrubs, is very remarkable. Of the four interesting Lauraceous trees of the Canaries, *Phoebe barbusana*, *Ocotea foetens*, *Laurus canariensis* and *Persea indica*, all occur in Madeira, and the latter two in the Azores. In this respect the finding by Carl Lindman* of pieces of Canary pine in the driftwood of the Norwegian Coast between Drontheim and Tanafjord is interesting, and it was probably carried there by the Gulf Stream. The nearest living relatives of the Canary pine are Mexican species, whilst a very closely allied fossil species† has been found in the lava of the Cantal district, South Central France.

In 1913, whilst on a visit to the island of La Palma (see *Kew Bull.* 1913, pp. 287-299), the writer had a good opportunity of exploring the forests of native pine, which cover the middle and upper slopes of the mountains, especially when ascending to the Pico del Cedro (l.c. 294) and whilst botanising in the great crater or Gran Caldera (p. 296), for which this island is justly famed. The photograph reproduced in Plate i. was taken in the Barranco del Rio, a deep rocky ravine to the north-west of Santa Cruz de la Palma. In this ravine the Canary pine is very abundant and covers the slopes from top to bottom, many of the specimens towards the dry stream bed being about 100 ft. high with stems about 2½ ft. thick. The second photograph (Plate ii.) shows the trees in the bottom of the crater, occupying even the hard pinnacles of basalt where there is scarcely any soil. The peaks in the distance are over 7000 ft. high, and about 6000 ft. above the nearly dry river bed in the foreground, which in the winter is a raging torrent, but which in summer supports an annual crop of very interesting plants.

* Lindman in Götesborgs Konig. Vet. o. Vitt. Sanch. Handl. (reviewed in Just, Jahresb. 1883, pt. ii, p. 125).

† Saporta in Comp. Rend. Paris, civ. 954-7 (1887).

II.—THE GENUS RHIZOPHORA IN BRITISH GUIANA.

Alleyne Leechman.

During a detailed study of the Flora of the sea-shore, undertaken by the writer during the past three years on a two-mile stretch of the coast in the immediate neighbourhood of Georgetown, the capital of British Guiana, it has become evident that there are three distinct forms of the genus *Rhizophora* present on the area under investigation. Their more obvious distinguishing characters are:—

Form i.—Inflorescence simple, few-flowered (2-3, occasionally 4); radicle up to 30 cm. in length; fruiting profuse. (= *R. Mangle*, L.)

Form ii.—Inflorescence much branched, many-flowered; flowers as in Form i., but slightly smaller; radicle, as in Form i.; fruiting much less profuse. (= *R. Harrisonii*, Leechman.)

Form iii.—A more robust plant than either i. or ii.; inflorescence much branched, many flowered; buds and flowers stouter than in either i. or ii., and calyces not so yellow externally; radicle up to 65 cm. in length, usually curved at the upper third; pericarp stout and curved. (= (?) *R. racemosa*, G. F. W. Meyer.)

Forms i. and ii. are common in the area studied, and all three are sharply defined. They grow closely together on the same ground, and retain their distinguishing characters. Form iii. is, however, rare in the area (sea shore near Georgetown and banks of the Essequibo river) and is evidently depauperate in the conditions prevailing. The contrast between Forms i. and ii. in fruiting habit is very striking—Form i. often sets fruit abundantly, while Form ii., although blossoming profusely, seldom sets more than a few straggling fruits per tree, and many specimens are quite barren.

Grisebach, in his Flora of the West Indies, describes only one species of *Rhizophora* (*R. Mangle*, Linn.), from that part of the world. In his description he states that the inflorescence is "usually few-flowered". Another species—*R. racemosa*, Meyer—is mentioned by him, but not described.

Jacquin's long and delightful account of *Rhizophora Mangle* leaves no doubt as to the identity of my Form i. "Pedunculi communes axillis insident solitarii" he writes, "pollicares, compressi, sulco longitudinali exarati, *biflori, bifidi, interdum triflori et obsolete trigoni*",† and of the "seed", which he states is the longest part of the fruit, "pollices decem ut plurimum longa". His drawing of the

* "Stirpes americanae," p. 141. pl. lxxxix.

† The italics throughout are mine.—A. L.

fruit is poor and contrasts unfavourably with his excellent representation of the inflorescence and flowers.

It is evident that my Form i. is *Rhizophora Mangle* as defined by Jacquin.

Meyer's description of *Rhizophora racemosa** is less satisfactory. "Inflorescentia composita haec stirps insigni modo a *Rhizophora Mangle cui ceterum similis discrepat*" he remarks. But both my Forms ii. and iii. have compound inflorescences, and they are clearly distinct species. Of the cymes Meyer says "rami et ramuli *crassi* . . . quinquies vel sexies repetito-dichotomi . . . multiflori . . . in utraque dichotomia e margine calyciformi sexdentato enati", all of which agrees with my Form iii.; but he concludes with "flores et fructus *Rhizophorae Mangle*, sed petala pilosa". The flowers and fruit of my Form ii. may be said to be those of *R. Mangle*, but the flowers of my Form iii. differ distinctly in their more robust habit, in their shape—which is not campanulate—and in the colour of the calyx, which is often quite green on the external surface, and is seldom bright yellow. The ripe buds—which I have found very useful for diagnostic purposes—are elliptical or slightly ovate, instead of cuneate as in the case of *R. Mangle*. The radicle, too, before the fruit falls is at least twice as long, generally strongly curved in its upper third, and green except at the distal end where it may become reddish-brown. *R. Mangle* has a radicle which is frequently entirely red-brown. Moreover, the pericarp of my Form ii. is very stout and is often curved. The petals in fresh specimens of my Form iii. are uniformly white and in my experience never saffron-yellow.

As to the leaves, Meyer's "foliis obovato-oblongis obovatisque" fits Form iii. very well, and the size given by Meyer—"uncias 4-5 longa, 2 lata"—also corresponds, but "subtus tenuissime tuberculata, punctis albidis adspersa" I cannot reconcile with any of my specimens. The spots on the dorsal side of the leaves are dark brown or blackish—"punctis *nigricantibus adspersa*" is Jacquin's phrase for the leaves of *R. Mangle*, which in this respect are similar to those of all the varieties examined by me. The spots are lenticels, formed by a hemispherical mass of wound cork, which develops round a stoma, isolating and killing it. It does not seem possible that such a structure could give rise to a white spot.

Oliver, in describing *Rhizophora racemosa* from Tropical Africa, says "Flowers in pedunculate, divaricate, shortly-jointed, many flowered cymes . . . pedicels and joints of cymes $\frac{1}{4}$ in. more or less". In my Form iii. the joints of the cymes are distinctly shorter than in Form ii., and sometimes may be actually stouter—which may account for Meyer's term "crassi". I am indebted to Dr. Stapf for the information that the plant generally accepted as *Rhizophora racemosa* from Africa closely resembles my Form iii. except for the petals, which are perhaps a trifle shorter and broader; and that Engler in Martius' "Flora brasiliensis" and Huber in "Arboretum amazonicum" mention

* "Primitiae Florae Essequeboensis," p. 185.

a *Rhizophora Mangle* var. *racemosa* but without discussing its peculiarities beyond the statement that its inflorescence is repeatedly branched. Oliver remarks that *R. racemosa* "occurs also in Tropical America, if this identification is correct".* It must be noted that Oliver describes *R. racemosa* as "a small tree", whereas in British Guiana, so far as I have seen, it is the largest of the three species I have noted. In British Guiana it is certainly a larger plant, in every way, than *R. Mangle*, which is described by Jacquin as attaining a height of "quinquagintapedalem . . . plerumque".

As Dr. Stapf very justly points out, it is not possible to decide the identity of my Form ii. with Meyer's *racemosa* until we are in a position to compare Meyer's orginal specimen of this species. It seems advisable, then, for the present to refer my Form iii. tentatively to *Rhizophora racemosa*, and to regard my Form ii. as a new species, for which I propose the name *Rhizophora Harrisonii*.†

I suggest the following diagnosis of my Form iii.

Rhizophora racemosa, *G. F. W. Meyer* (descr. emend.); a *R. Mangle*, L., inflorescentia dichotomo-paniculata, a *R. Harrisonii*, Leechman, pericarpio crassissimo et radicula longissima ad 65 cm. longa distincta.

Arbor magna, ad 25 m. alta, radicibus aeriis a ramis superioribus descendentibus. *Folia* 10-12 cm. longa, 4-5 cm. lata, supra saturate virentia, subtus punctis nigricantibus adspersa. *Petioli* crassi, 1·5-3 cm. longi. *Rami et ramuli inflorescentiae* crassi, seriatim breviores—pedunculi plus minusve 3 cm. articuli 10-5 mm. longi—in utraque dichotomia e margine calyciformi sexdentato enati. *Inflorescentia* ramosissima, quinquies vel sexies repetito-dichotoma, articulata, multiflora. *Alabastra* pallide flavo-viridia, ovata vel elliptica, 10-12 × 6-7 mm. *Calyx* viridis vel externe pallide flavescens, profunde quadripartitus, persistens, segmentis crassis ovato-lanceolatis subacuminatis coriaceis 10-12 × 6-7 mm. leviter patentibus. *Petala* 4, candida, linearia, acuminata, margine obsolete hirsuta, inter lacinias calycis valde reflexa, quibus paulo breviora et multo angustiora, caduca. *Antherae* saepe 8, aequales, aliquando 9-13 et, inaequales, corolla paulo breviores, caducae. *Stylus* fortiter sulcatus; stigmata 2-3, rarius 4. *Pericarpium* 4-5 cm. longum, 2 cm. latum, ovatum, crassum, scabriusculum, aliquando obsolete maculatum, saepe curvatum. *Radicula* omnium longissima, ad 65 cm. longa, pallide viridis, saepe curvata, apicem versus ferruginescens et sensim saepe ad 1·5 cm. incrassata.

This species appears to be the prevailing river type, and at Bartica, some 40 miles up the Essequibo River, it is the dominant mangrove plant.

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* "Flora of Tropical Africa," vol. ii, p. 408.

† In honour of Professor J. B. Harrison, C.M.G., M.A., Director of Science and Agriculture in British Guiana.

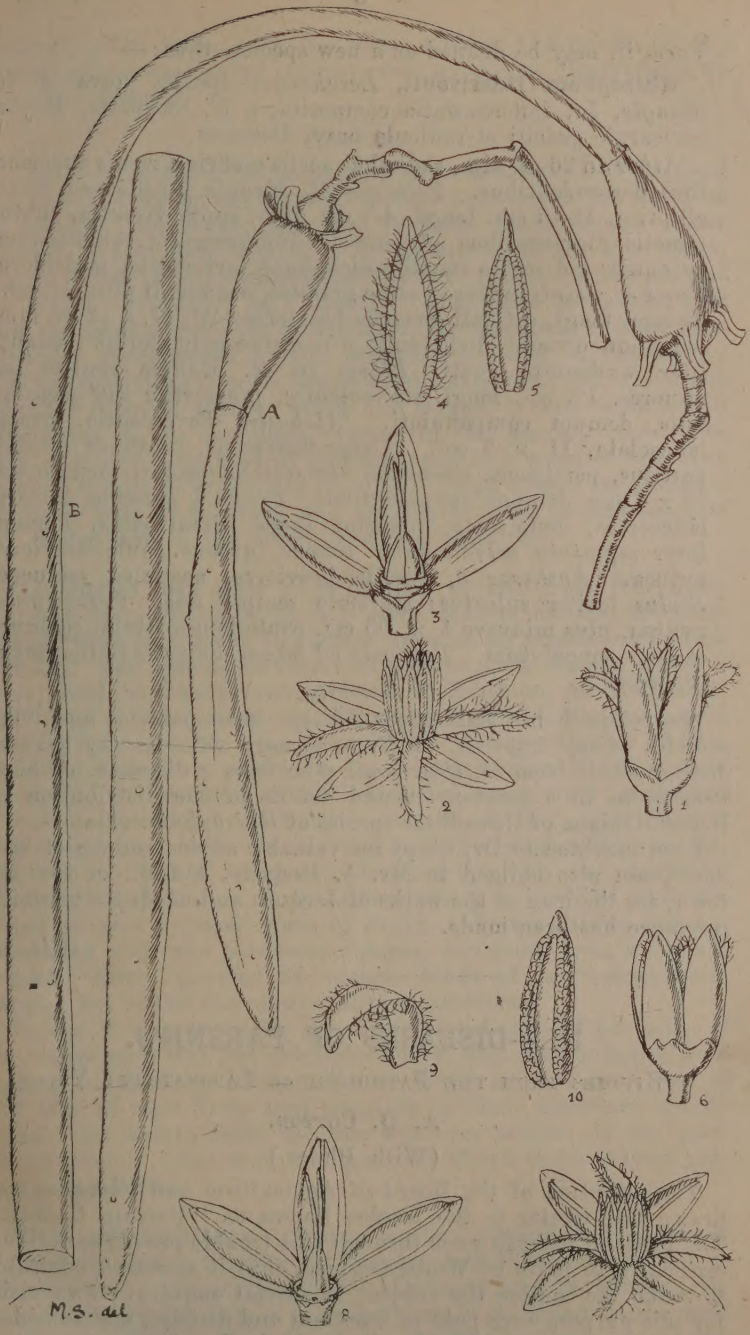

Fig. A. *Rhizophora Harrisonii*.—1. bud, 2. flower, 3. calyx and pistil, 4. petal, 5. stamen.

Fig. B. *Rhizophora racemosa* (?)—6. bud, 7. flower, 8. calyx and pistil, 9. petal, 10. stamen.

The figures have been drawn by Miss M. Smith from material sent over in spirit from British Guiana.

Form ii. may be defined as a new species, thus:—

Rhizophora Harrisonii, *Leechman*; species nova a *R. Mangle*, L., inflorescentia composita, a *R. racemosa*, Meyer, pericarpio gracili et radicula brevi distincta.

Arbor ad 20 m. alta, radicibus aeriis crebris a ramis superioribus descendentibus. *Folia* iis *R. Mangle* similia sed ferme elliptica, 11-15 cm. longa, 4-7 cm. lata, supra virentia, subtus punctis nigricantibus adspersa. *Inflorescentia* ramosissima, quinquies vel sexies repetito-dichotoma, articulata, multiflora. *Rami et ramuli inflorescentiae* graciles, pedunculi plus minusve 45 mm. longi, articuli seriatim breviores—20, 11, 9 et 7·5 mm. longi—in utraque dichotomia e margine calyciformi inaequaliter sexdentato enati. *Flores* iis *R. Mangle* similes sed minores, 1·3 cm. longi, suaveolentes, praesertim sub occasum solis, demum campanulati. *Alabastra* flavescentia, ovato-lanceolata, 11 × 5 cm. *Calyx* flavescens, profunde quadripartitus, persistens, segmentis coriaceis lanceolatis acuminatis 13 × 4 mm. demum late patentibus. *Petala* 4, candida, linearilanceolata, acuminata, margine saepe hirsutissima, demum inter segmenta calycis valde reflexa, quibus paulo breviora, caduca. *Antherae* 8, corolla breviores, aequales, caducae. *Stylus* leviter sulcatus; stigmata semper duo. *Pericarpium* rectum, plus minusve 4 × 1·5 cm. ovato-lanceolatum, scabrum et saepe maculatum. *Radicula* ad 30 cm. longa, omnino ferruginescens.

The robust habit, dark-green foliage, stout panicles and huge radicles of my form iii. (? *R. racemosa*) make it very easy to distinguish it from *R. Harrisonii* even from a distance. I hope soon to be in a position to add details of the distribution in British Guiana of these three species of *Rhizophora*.

I am indebted to Dr. Stapf for valuable advice and assistance, and I am also obliged to Mr. J. Rodway, F.L.S., of Georgetown, for the loan of the works of Jacquin and of Meyer to which reference has been made.

III.—DISEASES OF PARSNIPS.

STUDIES FROM THE PATHOLOGICAL LABORATORY: VI.

A. D. COTTON.

(With Plates.)

The attention of the Board of Agriculture and Fisheries was drawn last winter to the trouble known as "Parsnip Canker." The losses of parsnip roots through this trouble proved so serious, especially in parts of Worcestershire, that it appeared advisable to make the matter the subject of special enquiry. Two visits for this purpose were paid to Evesham and district, and considerable light on the subject has been obtained. At the same time several other minor diseases of parsnips, three of which were new to the country and one apparently capable of causing severe

damage, were noted. In the present paper the results of the investigations on Canker are recorded, as well as observations on the other diseases.

Canker.

That a certain number of parsnip roots in all parts of England are annually disfigured through surface-injuries on the shoulder is common knowledge, and that in some cases serious decay follows is also well known. In certain localities this decay, which occurs in late summer and autumn, is very prevalent, and is termed "Canker" or "Rust." The name is loosely used and the trouble not easy to define; it has apparently never been specially investigated. The brownish-coloured rot shown by affected specimens is not a characteristic symptom, but is common to other types of injury, being due largely to the oxidation of substances in the mucilage present in the parsnip root. The term "canker" as used by growers implies a more or less open wound, at first brownish-red in colour, which affects the shoulder or upper part of the root, and frequently leads in bad cases to the destruction of the entire root (see plate iii).

Damage in 1913 crop.—The trouble reported from Worcestershire at first seemed to be of a more definite nature, the roots having the appearance, in certain cases at all events, of a black wet rot. The specimens were communicated by Messrs. Yates & Sons, seed merchants and growers of Evesham, in December, 1916, and throughout the investigation Messrs. Yates have most freely given valuable help and advice. A large number of bacteria and fungi were present in the decaying roots, and in certain specimens the margins of the blackened areas were permeated almost exclusively by a fungus referable to the genus *Phoma*. The fungus was easily isolated and grew freely on various media, but was not found to agree satisfactorily with any described species of that genus. It was subsequently ascertained that this black rot was a special form of decay, and that canker was not associated with any particular fungus, but arose from a surface wound, which, invaded by various kinds of micro-organisms, rapidly led to the destruction of the root-tissues.

In the Evesham district it was estimated that 10 per cent. of the entire crop was lost through canker, and this, judging from figures supplied by Messrs. Yates, would amount to a loss of 370 tons of roots from seed supplied by their Evesham branch alone. In certain fields the loss was very severe; 50 per cent. of the crop in more than one case was stated to have been rendered unsaleable.

Field Observations.—Owing to the ground being frozen during the severe weather of January and February, a visit to affected areas was postponed till the beginning of March. By this date very few sound parsnips were to be found in the field in the neighbourhood of Evesham. In the localities visited the upper part of the root just visible above the soil was almost invariably undergoing decay through a white or grey wet-rot,

largely bacterial, the initial injury in most cases being probably due to some other cause. No specimens of the black *Phoma* rot were seen. It was ascertained that a more or less severe form of canker occurred over a wide area around Evesham, also in parts of Gloucestershire, whilst roots received from Somerset were almost completely destroyed through the same cause. In some cases where no rot, either wet or dry, was present a certain amount of the so-called canker was definitely attributed to the workings of Carrot Fly, and injury by this pest was found subsequently to be very considerable (see Bd. Agric. Leaflet No. 38).

At this season it was obviously too late to obtain a general insight into the nature of canker and of the black rot. A few simple tests, with regard to soil and culture for the coming season, were therefore arranged pending further examination in September, about which date canker was said to commence. These experiments included the dressing of the soil with lime, soot and sulphate of ammonia. This was carried out by several growers near Evesham, the fields being divided into four plots, the fourth plot being left as a control. Considerable improvement was expected from the use of lime, as, judging by the abundant growth of sorrel, the soil in some fields was decidedly acid. Trials at Kew were also planned, as described later.

At the beginning of September another visit was paid to Evesham. The fields of seven large growers were inspected, and also the gardens of several others where parsnips were grown on a smaller scale. By this date canker had been reported from several market gardens, and, as was subsequently discovered, was in certain localities far advanced. It was regarded as being on the whole decidedly earlier in its appearance than in previous seasons. No destructive black rot was observed, though in advanced cases a grey, wet rot had commenced. Canker was noted as being more prevalent on forked or mis-shapen roots.

The effect of the various dressings employed was first examined. To form a really true estimate it would have been necessary to lift a large number of roots and have a somewhat detailed knowledge of the character of the soil and its previous history with regard to manuring. This much, however, may be said: in most fields the distribution of the canker appeared fairly uniform and to be unaffected by the dressings which had been applied. The application of sulphate of ammonia did not apparently result in any very great increase in the growth of the parsnip nor in the amount of disease. No very striking results were, however, anywhere apparent, though, on the whole, canker appeared to be distinctly worse where liming in the past had been omitted.

With regard to the physical nature of the soil and its relation to canker, in the opinion of several growers the driest lands suffer most severely. Without controverting this statement it may be mentioned that it was not corroborated during the visit. The two worst and most advanced stages of decay were found in both cases on wet heavy land (Pebworth and Sedgeberrow). A bad case was noted on light land (Fladbury). On the whole, canker appeared least prevalent on medium loam.

Animal and fungus injury were next searched for. The former was observed in some variety. The workings of the carrot fly larvae were manifest both in field and garden crops. Slug-injury was also noted, and the occasional presence of wireworms and surface caterpillars (*Agrotidae*), locally termed "leather grubs," doubtless accounted for other damage. The millipede (*Julus pulchellus*) was often abundant in the decaying parts. These animals, however, were far too few in number and too irregular in distribution to be for a moment considered as being primarily responsible for canker. Carrot fly was the most general, but it was usually sparsely distributed except in small gardens and allotments, and the characteristic tunnellings which the larvae produce, not only on the shoulder but in all parts of the outer tissue of the root, form a very definite and distinct type of injury.

Cause of Canker.—The cause of canker was more satisfactorily sought for in injuries noticeable at once in examining slightly attacked specimens—namely, the cracking of the outer skin of the root. This cracking was noted the first day, and, without ceasing to search for all indirect and subsidiary causes, was made the subject of special investigation during the remainder of the visit. The cracks were, as a rule, $\frac{1}{2}$ to 2 in. long and $\frac{1}{10}$-$\frac{1}{2}$ in. across, and occurred either as vertical concentric slits around the top of the shoulder or ran horizontally around it at a distance of not more than about $1\frac{1}{2}$ in. below the top. Vertical cracks running down the side of the root were also present, and these appeared to be formed simultaneously with the horizontal ones to which they were, as a rule, united at their upper end. The cracks were entirely superficial, being confined to the periderm and a few layers of cortical cells. They gaped considerably, and exposed the cortex to view as a soft white spongy tissue.

The stages of decay from badly cankered spots to small and sound cracks could be traced without difficulty (see Plate iv). The fresh wounds were perfectly clean (Plate iv, figs. 1 and 2), but the cortical tissue within soon became attacked by animals, such as slugs and centipedes, and by various fungi and other micro-organisms. The cracks were obviously due to the expansion of the root-tissues and not to the agency of outside organisms, and were comparable to the familiar growth-cracks in carrots, but were mainly horizontal instead of vertical, and differed strikingly in being confined practically to the outer skin or rind. Subsequent observations entirely confirmed the view that canker originated from these surface lesions. That it may follow as a result of other wounds, such as carrot-fly injury is possible and even probable, but it was obvious that a very large proportion of the trouble in Worcestershire is, primarily, due to this rupture of the periderm. The cause of crack-formation and subsequent decay of the inner tissues is discussed later.

Experiments at Kew.—Although the origin of the canker had been traced to the surface lesions described above, the organisms concerned with the actual decay had not been classified and

isolated. Their distribution in the soil and their relative abundance in different localities was unknown. For this reason the results of the soil experiments at Kew arranged the previous spring may be recorded here. Five plots of Parsnips were sown in April 1917, and were treated as follows:—

Plot A inoculated with 2 bushels of infected Evesham soil.
Plot C inoculated with cut-up diseased roots from Evesham.
Plot D inoculated with cut-up diseased roots from Somerset.
Plots B and E served as controls.

The diseased roots and soil which were obtained from Worcestershire and Somerset in March were added with a view to inoculating the soil with any organisms, parasitic or otherwise, which might be concerned with the production of canker. The variety of Parsnip sown was the same as that very largely used in Worcestershire, a broad-shouldered form of "Hollow Crown."

Preliminary examination in August and September showed the presence of many small cracks, but no marked development of canker. The plots were finally cleared on November 12, by which date a considerable number of cankerous wounds had developed. The results are set out in the accompanying table:—

			per cent.
Plot A.—Inoculated with Evesham soil (total number of plants = 96).	Sound	65	68
	Cracked	17	18
	Cankered or commencing to canker	14	14
Plot B.—Control (total number of plants = 178).	Sound	103	58
	Cracked	42	23
	Cankered or commencing to canker	33	19
Plot C.—Inoculated with diseased roots from Evesham (total number of plants = 76).	Sound	50	66
	Cracked	13	17
	Cankered or commencing to canker	13	17
Plot D.—Inoculated with diseased roots from Somerset (total number of plants = 99).	Sound	62	63
	Cracked	22	22
	Cankered or commencing to canker	15	15
Plot E.—Control (total number of plants = 168).	Sound	118	70
	Cracked	26	15
	Cankered or commencing to canker	24	15

From the above it will be seen that from 15-23 per cent. of the cracking occurred in all plots, and from 14-17 per cent. of canker. The figures for the latter are high, but except in plot C the canker was in an early stage, and the roots were marketable and not appreciably damaged. In plot C eight roots had badly decayed, but from the presence of equally severe injury noted in some neighbouring plots (not included in the experiment) this

cannot, without further proof, be attributed to the effect of the inoculation with diseased roots. It may be due to early cracking and early commencement of decay. The experiment tends to show that inoculation with diseased material had no effect, since of the controls one (B) showed the maximum amount both of cracking and of canker, and the other (E) almost the minimum.*

In addition to the above, efforts were made by means of direct observation of roots in the Kew plots to follow the course of development of the cracks and the subsequent decay. The results were not conclusive—a fact which may be partly due to the observations being made late in the season, namely, in September, after the return from Worcestershire. Nine growth-cracks on roots in plot B were carefully examined and measured, the roots being left *in situ*, the soil merely scraped away for purposes of inspection, and replaced at once. The weather was somewhat dry for the first ten days after marking. After two weeks the plots were examined, when but little extension of the cracks and no decay had taken place. Two weeks later, after considerable rain, a little decay had commenced and some new cracks had appeared. After another fortnight, *i.e.*, six weeks after marking, the roots were lifted and examined, with the following results:—Three slits had not increased in size and remained sound, 3 had distinctly increased in size yet remained sound, 3 had increased in size and developed cankerous wounds. Some 6 or 7 new cracks had developed, all of which remained sound.

In another set of roots on the same plot a series of shallow vertical cuts on the top of the crown resembling growth-cracks were made with a knife. Examined 6 weeks later, four remained sound and two developed into a cankerous wound.

A similar experiment was performed on plot C (infected soil) with the addition of 12 horizontal cuts on the side of the root. All these cuts, however, remained sound. It was noted that an injured surface attracted slugs, slug-injury being obvious both in growth-cracks and artificial cuts.

Summing up the Kew experiments, it may be said (1) that growth-cracks occurred at Kew as in Worcestershire, but they were decidedly smaller in size and later in developing; (2) that canker followed in a few cases as a result of these or other injuries; and (3) that canker was found to be no more frequent in the plots inoculated with Evesham soil or with diseased roots from Evesham than in the ordinary Kew soil. The less extensive cracking may perhaps be accounted for by the small size of the roots. This was due to the seed being sown late (mid-April) and the soil being a heavy compact silt which had not been manured for two years.

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* Experiments carried out by Messrs. Yates at Evesham for testing the effect of manures showed a distinctly larger percentage of canker than at Kew. The use of lime proved highly beneficial both with regard to size of roots and reduction of canker. The use of manures alone, such as Peruvian guano, sulphate of ammonia and superphosphate of lime, was not successful in mitigating the disease.

Anatomical considerations.—The parsnip root consists of a central core of xylem surrounded by a mass of soft spongy parenchyma. The whole is bounded by a thin periderm. The relative amount of core and soft outer flesh differs somewhat in different varieties, but as a rule the fleshy tissue is largely in excess of the core, and it is the aim in selection to keep the central core as small as possible. The core is composed almost exclusively of secondary xylem, but it contains a very large amount of xylem parenchyma, hence it is comparatively soft. The outer fleshy portion consists essentially of secondary cortex: it is composed entirely of parenchymatous and other soft elements which are produced abundantly from the cambium. The cells are densely packed with starch. Through the cortex runs a system of mucilage canals, which are especially found immediately beneath the periderm. The secretion may be seen exuding from roots on freshly cut surfaces as a white milky fluid, which turns reddish-brown on exposure to the air; this change of colour, as is shown by the guaiacum test, is due to the oxidation of some substances contained in the fluid.

The periderm surrounding the root is formed from a phellogen which arises in the inner tissues of the root, probably in the pericycle, at a very early stage. In the young growing apex of the root the phellogen and three or four layers of periderm are clearly visible in transverse section. In older roots the periderm appears, owing to tangential stretching, to be less regular. In median longitudinal section, however, the regular arrangement of the cells, obviously of secondary origin, is quite clear. This thin layer of periderm is interrupted only in the furrows marking the emergence of the lateral roots, where a thick pad of corky tissue is present.

It is obvious to the naked eye that the cortical tissue exposed to the air as a result of cracking does not heal over. Anatomical examination shows, however, that an attempt is made on the part of the plant to protect itself, inasmuch as the outer and side walls of the exposed cells become suberised. A few cell-divisions also take place, but there is no trace of a definite phellogen or of a layer of wound-cork. This protection is quite inadequate to keep out micro-organisms, the inter-cellular spaces and cracks or fissures due to drying providing ample means of entry. The soft parenchymatous tissues are, moreover, specially attractive to slugs, an immense amount of slug-injury being noticeable if large gaping slits are made with a knife. It is therefore not surprising that decay sets in and canker follows, and the cause may be said to be entirely due to the inability of the parsnip to form a protecting layer of wound-cork. The deep open clefts which occur in the roots of swedes, carrots, mangolds, and turnips become protected on their surfaces by a thin cork layer. No cork layer is formed when such deep cuts are made artificially in the parsnip. It would appear, therefore, that the hindrance to cork-formation is not due to the different method of cracking, but to some physiological peculiarity of the parsnip root.

The Causes of Cracking and Remedies.—The formation of growth-cracks is a phenomenon familiar enough to gardeners, and is of common occurrence not only in root crops, but in fruits such as apple, pear, and cucumber. In the pulpy fruits of plum, cherry, and tomato a cracking of the skin is also frequent, and in this case, as in the parsnip, decay results.

Cracking is brought about by an unequal growth in the structures concerned; the inner tissues grow more rapidly, and ultimately rupture the outer layers. In the case of the pulpy fruits mentioned, cracking may be partly due to excessive turgidity of the inner cells. In either case it is, as a rule, due to the effect of an abundant supply of water at the root after a dry period, but at times it appears to be merely the result of rapid growth, when the expansion of the surface tissues does not keep pace with that of the inner. The effect of hot sun and dry conditions, especially, if there is not a copious supply of water at the root, is to ripen growth, and this entails, amongst other things, loss of elasticity in the cell-walls and decrease of the power of cell-division. Dry conditions, whether in the case of fruits or roots, are felt first at the surface, and hence surface tissues are more subject to premature ripening. If late summer rains stimulate new growth, the outer, partly ripened tissues respond more slowly, and if the pressure from within be excessive they are liable to become ruptured.

The above considerations apply to the parsnip and explain to a certain extent the cause of cracking. It is obvious that the very wet September of 1916 following the warm, dry August was conducive to late and rapid growth, which would, for the reasons given, lead to extensive cracking of the surface tissues of the root, and an unusual abundance of canker. In 1917 canker may have been increased by the wet August. From information collected from various growers cracking was general in 1916 in parsnip-growing localities though the losses elsewhere were much less serious than at Evesham. One may inquire therefore as to the presence of special conditions at Evesham, which might tend to aggravate the trouble.

On the cultural side there is evidence of several contributory factors. In order to obtain a heavy crop the seed is sown in February, at an earlier date than formerly. By this method the roots reach a large size by July and August, and there is probably a tendency to premature ripening. This theory receives support from the fact that several growers maintain that liability to canker is lessened by late sowing. The soil itself may be too rich. Though fertilizers are never applied directly to the crop, the Evesham soil is well known often to be highly manured, and given favourable weather conditions this would lead to excessively rapid growth, and consequently risk of much cracking. A highly fed plant, moreover, would decay rapidly. In addition there is evidence, in the case of certain growers at all events, that parsnips are grown on the same land for two years in succession and that a proper rotation is not given. The effect of the latter course is not only unfavourable for parsnip growth, but tends to stock

the soil to the full with the particular organisms, both animal and vegetable, concerned in their decay, and hence if cracking occurs the parsnip might be expected to be rapidly destroyed. Lastly, liming has been neglected. Experiments carried out by Messrs. Yates in 1917 show a decided improvement where lime was applied.

Yet another cause of the severity of the canker attack may lie in the nature of the variety of parsnip grown. As already mentioned breeders aim at a small core and ample flesh, an ideal well seen in the Evesham parsnip root, which is noted for its bulky fleshy top. Such a soft mass of parenchymatous tissue would probably be easily stimulated to extensive growth after rainy periods during the summer months and to rapid expansion of the inner tissues. The breeders may have exceeded the limits in that direction and produced a parsnip particularly subject to a physiological defect. As evidence in favour of this view it may be mentioned that in allotments in Worcester, though the long slender parsnip such as "Student" showed rupturing of the rind and a certain amount of canker, these were not so extensive as in the Evesham parsnip.

Preventive Treatment.—In order to reduce the amount of surface-cracking and canker the following treatment, based on the above conclusions, may be recommended:—

1. Too rich a soil must be avoided.
2. Late sowing should be adopted. Such observations as it has been possible to make in 1917 tend to confirm growers' statements that plants sown in the end of April or beginning of May suffer much less than those sown in February.
3. Liming must not be neglected. As well as improving the tilth, lime acts by liberating reserves of nitrogen and potash, and its effect on the parsnip is seen in the improved quality of the crop both in size of roots and decrease in the amount of decay.
4. A dressing of salt has been found very effective by some growers. On heavy soils 5 cwt. per acre should be applied, and on light soils up to 10 cwt. per acre may be used. The salt may act by liberating a certain amount of potash from the soil, and one of the most marked effects of potash is to retard maturation and to enable the plant to continue its vegetative growth. It is possible that this effect may extend to the phellogen (rind-producing layer) and consequently render it less liable to rupture. For the same reason potash manures should prove beneficial.
5. A proper rotation should be given, and parsnips must never be grown for two years in succession on the same land.

Summary.—The canker of parsnip or the decay of the upper part of the root during late summer and autumn is a disease

well-known to growers, but one which has apparently never been investigated. In certain districts it has recently been on the increase and is responsible for serious losses. It is shown to be due primarily to a physiological phenomenon which causes the surface tissues to become ruptured, and not to the invasion of a fungus parasite. Cracking takes place during the growing season especially if rains follow a dry period, the portion involved being the skin, *i.e.*, the periderm and the outermost layers of the cortex. The cracks, which for the most part run horizontally around the upper part of the root but also in a vertical direction, are from ½ to 2 in. long and gape open exposing the soft inner tissues.

The "canker" or decay which follows is shown to be the result of the inability of the parsnip to form a layer of wound cork. Though the outer walls of the exposed cortical cells become suberised and few cell-divisions occur no definite phellogen is formed, and the growth-cracks are not protected as they are in the case of carrots, swedes, and other fleshy roots. The suberisation of the outer walls is insufficient to exclude micro-organisms, which enter, probably by means of intercellular spaces and fissures due to drying, and more or less rapidly destroy the tissues of the root. Though canker is worse in some localities than others it appears to occur in all districts if rupturing of the skin takes place. No one micro-organism specially connected with the decay has been isolated.

The conditions leading to crack-formation are discussed. It is shown that whilst such cracks are due to an unequal rate of growth, the inner tissues growing more rapidly than the outer, and are governed very largely by weather-conditions, their formation may be favoured by certain methods of culture, namely, over-manuring, neglect of liming and by early sowing (inducing premature ripening). The variety of parsnip grown may also be partly responsible, a form of high quality, with bulky top, abundant flesh, and small core, being very largely cultivated in the worst infected areas.

Control measures consist in rectifying the faulty methods of culture alluded to, and the use of potash and common salt with a view to retarding maturation.

Other Parsnip Diseases.

Erysiphe Polygoni, *DC.* The Parsnip Mildew.

This fungus, which attacks many cultivated plants, occurs frequently on Parsnips, being found very plentifully in the market gardens around Evesham and Wisbech; it has also been noted elsewhere. The perithecia are found late in the season both on the leaf-blade and the petiole, but especially the latter. The attack is not sufficiently severe to necessitate treatment.

Phyllachora Pastinacae, *Rostr.* Plantepatologie, p. 511.

New to Britain. The conidial (*Cylindrosporium*) stage of this species was found attacking a certain number of parsnips with great severity in a market garden at Mickleton (Glos.). The disease shows itself first as brown spots on the upper

surface of the leaves. These later coalesce and form extensive brown areas. On the under side the minute sori are visible as black shining areas, just visible to the naked eye though they may ultimately reach 2 mm. in diameter. Occasionally they appear also on the upper surface. In bad cases the whole foliage including the petiole is attacked and killed, and as it becomes browned and scorched in appearance diseased plants stand out clearly in the field.

Although neither the ascigerous nor conidial stages of *P. Pastinacae* have been previously recorded for this country there can be little doubt that the fungus occurs frequently, but has been overlooked. Further it is probable, since their morphological characters are identical, that *P. Pastinacae* is synonymous with *P. Heraclei* which is not uncommon in England on Cow Parsnip (*Heracleum Sphondylium*). The parasite has undoubtedly spread to the cultivated from the wild plant and is attacking it severely, a disquieting circumstance in view of the fact that there is some evidence that the now widespread and injurious Celery Blight (*Septoria Apii*) originally spread to Celery from the wild *Apium* (*vide* Pethybridge, Journ. Roy. Hort. Soc. vol. xl., pp. 476-480). The spore measurements of the conidial stage given in Saccardo are incorrect, and a revised description is given below.*

P. Pastinacae, *Rostr.—Cylindrosporium Pastinacae,* Lind. Danish Fungi, p. 493. *Septoria Pastinacae,* Westend, Herb. Crypt. Belg. no. 639.

Sori on the under side of the leaf, scattered or gregarious, not on distinct spots, immersed in the tissue of the leaf. Pycnidial wall lacking, spores set free through the ruptured epidermis. Conidia hyaline, strongly curved, falcate, ends rounded, at first with a few oil-drops, finally 1-septate, rarely with a second septum, 50-70 × 4-5 μ.

Ramularia Pastinacae, *Bubák.*

New to Britain. The fungus, which was usually accompanied by *Cercosporella Pastinacae,* Karst., forms small brown but conspicuous spots on the leaves, and elongated spots on the petioles. It was found generally distributed in Worcestershire and was noted also in Gloucestershire, and Cambridgeshire. It is probably widely spread in England but has been overlooked. On the leaves the spots are angular, being bounded by the veinlets (Text fig. 1a), a character which serves to separate it from *Cercosporella*. The spores show as a delicate white mould on the lower side.

In crowded gardens and allotments the spotting was severe and sufficient seriously to weaken the plants; in the open fields the damage was insignificant. The synonomy and description are as follows:—

* For assistance with regard to the identification, synonomy and description of these new records and also for the text figures, I am much indebted to Miss E. M. Wakefield of the Kew Herbarium.

R. Pastinacae, *Bubák* in Sitzber. böhm. Ges. Wiss. Prag. Sep. 1903, p. 19. ? *R. Pastinacae*, Lindr. et Vestergr. in Acta Soc. Faun. Flor. Fenn. xxii., No. 3, 1902, p. 8 (non *Cercosporella Pastinacae*, Karst. in Hedwigia xxiii., 1884, p. 63).

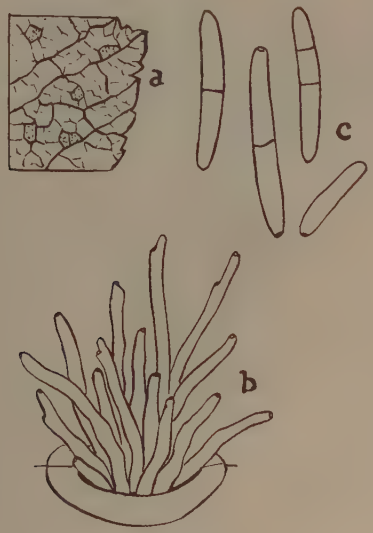

Fig. 1.—*Ramularia Pastinacae.*
(a) Portion of leaf showing angular spots (nat. size).
(b) Tuft of conidiophores emerging through a stoma (× 850).
(c) Spores (× 850).

Spots on the leaves, definite, more or less angular, limited by the veinlets of the leaf, 1-2 mm. in diameter, at first dark greyish-green, then brown; spots on the petiole, dark, much elongated up to 2 cm. long by 2-3 mm. wide. Sori minute, crowded, chiefly on the under-surface, but also epiphyllous, white or very pale rose-tinted. Conidiophores fasciculate, emerging from the stomata, cylindrical, unbranched, finally more or less toothed towards the apex, 30-75 × 2·4-4 μ. Conidia cylindrical, straight or very slightly curved, ends rounded, at length 1-septate, or rarely 2-septate, sometimes in short chains, 15-27 (9-35) × 3·5-4 μ Text figure 1 a, b, c.

Cercosporella Pastinacae, *Karst.*

New to Britain. Found on leaves and petioles and closely associated with *Ramularia Pastinacae*. Only a slight attempt was made to separate the two fungi in the field from which it appeared that the *Cercosporella* is by far the least common. When unmixed with *Ramularia* the spots are round (text figure 2 a), but as a rule the two fungi occurred together and their general distribution appears similar.

With regard to the identity of the fungus there appears no doubt that it is the same as Karsten's. Lindroth and Vestergren

(Acta Soc. Faun. Flor. Fenn. xxii., 1902, No. 2, p. 8) stated that Karsten's fungus was a *Ramularia*, with 2-celled, rod-shaped conidia germinating soon after maturity. This description would apply to *Ramularia Pastinacae*, Bubák, but not to Karsten's own description of the long, tapering conidia. In view of the close association of the two species noted in England, it seems legitimate to conclude that Lindroth and Vestergren must have seen only the *Ramularia*, and erroneously supposed it to be Karsten's *Cercosporella*. They do not, moreover, state whether they examined the type material. The description is as follows:—

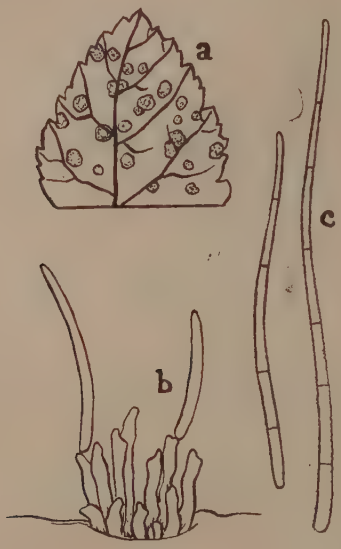

Fig. 2.—*Cercosporella Pastinacae.*

(a) Portion of leaf showing round spots (nat. size).

(b) Tuft of conidiophores with young spores (× 850).

(c) Spores (× 850).

C. Pastinacae, *Karst.* in Hedwigia, xxiii., 1884, p. 63.

Spots rounded, not bounded by the veinlets, 1-3 mm. in diameter, at first brown, then becoming white in the centre, with a light brown margin, edge slightly elevated on the upper surface of the leaf. Sori chiefly on the under side, but also epiphyllous, minute, white pulverulent. Conidiophores short, flexuous, indistinct, 10-20 × 2·5-3 μ. Conidia hyaline, slender, tapering gradually towards the apex, with 3-6 indistinct septa, 35-90 (-105) × 2·5 μ.

Text figure 2 a, b, c.

III.

PARSNIP CANKER.

[*To face page* 20.

IV.

PARSNIP CANKER.

To face page 21.]

Plasmopara nivea, *Schroet.*

In 1917 this well-known parasite on the *Umbelliferae* appeared on parsnips late in the season, being noted abundantly near Wisbech in the end of September. In October Messrs. H. Wormald and E. W. Swanton forwarded material from near Ashford and Haslemere respectively, and signs of its presence were observed later in several other localities. The fungus shows first as pale spots or ill-defined areas on the upper surfaces of the leaf with a delicate white mould protruding below. With age the spots increase in size and become dark in colour, forming irregular blotches several centimetres across, similar in form and appearance to those caused by *Phytophthora infestans* in potato, a character which distinguishes it from any of the other diseases previously mentioned. In one garden near Wisbech where parsnips were grown between fruit trees, a considerable amount of the foliage was destroyed by this fungus.

EXPLANATION OF PLATES III & IV.

III. Typical example of Parsnip canker.

IV. Illustrating formation of growth-cracks and subsequent development of canker: (1) Horizontal cracking; (2) horizontal and vertical cracking; (3) commencement of decay; (4)-(6) further stages of decay and production of canker.

IV.—TAGASASTE AND GACIA.

(*Cytisus* spp.).

J. HUTCHINSON.

Amongst a donation of Canary Islands' seeds for distribution, Dr. G. V. Perez, of Orotava, Tenerife, has forwarded to Kew several pounds of "Tagasaste," *Cytisus proliferus*, var. *palmensis*,* Christ, "Gacia," *Cytisus stenopetalus*, Christ, and "Gacia blanca," *Cytisus pallidus*, Poir. In various communications to Kew, Dr. Perez has repeatedly urged the importance of Canary Island fodder plants, especially the "Tagasaste," for planting in warm dry countries, such as North and South Africa, Australia and the near east; whilst "Tagasaste" was the subject of a pamphlet by Dr. Perez's father, Dr. V. Perez, and Dr. P. Sagot, published in Paris in 1892. The *Kew Bulletin* for 1891, pp. 239-244, contains a number of extracts from the Kew Reports giving particulars of the distribution of "Tagasaste" seed from Kew to various Colonies, and some of the results therefrom; and Sir Daniel Morris, in the *Kew Bulletin*, 1893, pp. 115-117, gave his own personal observations of the shrub in the Canary Islands. These papers should be read in conjunction with the present notes. Recently Mr. J. H. Maiden has given a comprehensive account of the shrub in the Agricultural Gazette of New South Wales, for October, 1915, pp.

* In the present paper treated as a separate species, *C. palmensis*, Hutchinson.

883-887. In the same journal (p. 888), there is a government recommendation for the encouragement of growing "Fodder Trees as a Resource in Time of Drought," the species recommended being the "Kurrajong" (*Hibiscus heterophyllus*, Vent.), "Mulga" (*Acacia anevra*, F. V. Muell.), "Carob Bean" (*Ceratonia siliqua*, Linn.), "Tree Lucerne" (*Sida rhombifolia*, Linn.), and the native "Salt bush" (*Atriplex campanulata*, Benth.). From what we know of "Tagasaste," it seems probable that it and the other two Cytisi mentioned above might be suitable for inclusion in such a list, as they appear to be particularly adaptable for this purpose. It is true that in some places, notably South Africa* "Tagasaste" is not held in very high esteem, but Dr. Perez thinks that this may be due partly to faulty cultural methods.

For its successful cultivation as a forage plant, two important considerations are strongly emphasised both by Dr. Perez and Mr. Maiden; firstly, that it is useless to allow the shrub to grow without attention, and, secondly, that the taste of animals for the shrub is an acquired one, and they must first of all be taught to eat it, if necessary, by a little starvation. The seeds are very hard and slow in germination, so that before sowing they should be either chipped or soaked in hot water. After about three seasons' growth, the branches should be pruned hard back like a willow, and the young shoots cut off yearly and used for feeding stock. In La Palma, Canary Islands, where "Tagasaste" is native, scarcely anything else is used for feeding animals during the long dry summer season, and the writer has himself seen pack-mules feed greedily on it. In districts that are liable to prolonged periods of drought and consequent serious losses among stock, such as occur in certain parts of Australia, there seems no reason against "Tagasaste" being planted in or as hedges and clipped annually for use during drought when ordinary pastures fail.

As the result of a critical examination of these Canary Island *Cytisi*, it has been found that three distinct species have been confused under the name of *C. proliferus*, Linn. They are distinguished from one another not only by striking differences in the shape of the leaves, and especially by their hairy covering, but each is characteristic of either one or at most two islands of the Canary Archipelago, whilst there is, in addition, a difference in value as fodder as well as constant segregation under separate vernacular names by the peasant people of the Canaries, who are remarkably intelligent about their crops and plants. The extreme endemism of the species of *Cytisus* in separate islands is remarkable, two of the islands, La Palma and Grand Canary, having each two species, and Gomera and Tenerife one species each peculiar to them. This subject, and a detailed account of the Canary species of the genus, may, however, be more suitably dealt with in a separate paper.

The following is a summary of the most obvious differences among the three forage plants mentioned above and of the species with which they have been confused.

* See the South African Agricultural Journal, v. 134 (1913).

**Leaves densely silky-hairy on both surfaces:—*

1. **Cytisus pallidus,** *Poir.*—Laxly leafy; leaflets rather elongate-lanceolate, averaging about 4 cm. long and 7 mm. broad, silky-hairy above, silvery below with long closely appressed hairs; bracteoles as long as or longer than the calyx; calyx-lobes linear-subulate.
   Endemic to La Palma. Native name "Gacia blanca."

2. **Cytisus Perezii,** *Hutchinson,* sp. nov.—Very densely leafy; leaflets distinctly obovate, averaging about 3 cm. long and 1·2 cm. broad, densely clothed with long closely packed silky hairs on both surfaces; bracteoles much shorter than the calyx; calyx-lobes triangular-lanceolate.
   Endemic to the islands of Grand Canary and Hierro. Native name "Escabon de Canaria."

***Leaves densely silky-hairy only on the lower surface, the upper surface glabrous or nearly so:—*

3. **Cytisus proliferus,** *Linn.*—Rather densely leafy; leaflets linear or linear-oblanceolate, averaging about 3 cm. long and 0·5 cm. broad, glabrous or very nearly so above from the beginning, but especially so when mature, closely silky-hairy below.
   Endemic to Tenerife and Gomera. Native name "Escabon."

****Leaves glabrous or thinly pubescent with few short scattered hairs:—*

4. **Cytisus palmensis,** *Hutchinson,* sp. nov.—Laxly leafy; leaflets rather broadly lanceolate, averaging 4·5 cm. long and about 1·2 cm. broad, glabrous or nearly so on both surfaces, but especially so below; racemes shorter than the leaves and few-flowered; bracteoles much shorter than the calyx; calyx-lobes triangular-lanceolate.
   Endemic to La Palma. Native name "Tagasaste."

5. **Cytisus stenopetalus,*** *Christ.*—Laxly leafy; leaflets obovate or obovate-oblanceolate, averaging 2·5 cm. long and 0·8 cm. broad, thinly and shortly pubescent; racemes overtopping the leaves, many-flowered; bracteoles half as long as the calyx; calyx-lobes triangular-lanceolate.
   Endemic to La Palma, Gomera and Hierro. Native name "Gacia."

1. **Cytisus pallidus,** *Poir.* Encycl. Suppl. ii. 442 (1811); Bot. Mag. t. 8578.

* Readily distinguished from *C. maderensis,* Masf., from Madeira, with which it was united by Briquet, by the extremely short cinereous indumentum of the branchlets; in *C. maderensis,* they are densely fulvous-tomentose.

Genista splendens, Webb. in Webb. et Berth. Phyt. Canar. ii. 43 (1836-50). *Teline linifolia*, var. *latifolia*, Webb. l.c. 42; Pitard et Proust, Fl. Canar. 151 (1908). *Cytisus linifolius*, var. *pallidus*, Briq. Les Cytis. des Alpes Marit. 140 (1894).

Canary Islands. Palma: Barranco del Rio, 1843, *Webb*; cliffs above Tenerra, Caldera, *Sprague and Hutchinson* 466; cultivated by *Dr. G. V. Perez* at the Villa Orotava, Tenerife.

This is reputed to be a valuable forage crop (*vide* Dr. Perez), and is known to the peasants of La Palma as "Gacia blanca"; the local name in Webb's time was "Herdanera." It is, however, neither so good nor so vigorous a forage plant as "Gacia," *C. stenopetalus*.

2. **Cytisus Perezii,** *Hutchinson*, sp. nov.; *C. proliferus*, var. *Canariæ*, Christ in Engl. Bot. Jahrb. ix. 120 (1887) var. *laxiflorus*, O. Kuntze, Revis. Gen. Plant. i. 178 (1891).

Frutex vel arbor parva, multe ramosa; rami breves, subdense foliati, dense molliter tomentosi. *Folia* brevissime petiolata, trifoliolata; foliola obovata vel oblanceolata-obovata, ad apicem breviter mucronatum rotundata, ad basin cuneata, 2-3·5 cm. longa, 1-1·5 cm. lata, tenuiter chartacea, utrinque pilis nitidis sericeis appressis permanente dense obtecta; petioli usque ad 1 cm. longi, molliter tomentosi. *Flores* in ramulos breves axillares conferti; pedicelli usque ad 1·5 cm. longi, nutantes, molliter fulvo-tomentosi. *Calyx* circiter 1·3 cm. longus, extra dense fulvo-villosus. *Vexillum* orbiculare, breviter unguiculatum, circiter 1·8 cm. longum et 1·3 cm. latum, apice leviter emarginatum, dorso sericeo-pilosum; alae oblique oblongae vel semilunares, apice rotundatae, uno latere undulate auriculatae, ungue 5 mm. longo glabro, lamina 1·5 cm. longa latere inferiore breviter ciliata; carinae petala aliis simillima sed minora et longiore auriculata. *Tubus staminalis* 1·3 cm. longus. *Ovarium* appresse villosum, stylo curvato basin versus parce pubescente. *Fructus* non visus.

Canary Islands. Grand Canary: Firgas, *O. Kuntze*; without definite locality, *Bourgeau*; *Lowe*; *Finlay*.

Hierro: About a mile from Valverde, towards the port, *Lowe* 70; above the church at El Golfo, *Lowe* 70.

Vernacular "Escabon de Canaria."

It gives the writer much pleasure to associate with this species the name of Dr. G. V. Perez, who has provided a liberal supply of his cultivated Canary Islands' Cytisi, and whose kindness to the writer and his companion during their visit to Tenerife will not be readily forgotten.

3. **Cytisus proliferus,** *Linn. f.* Suppl. 328 (1781). *C. proliferus*, vars. *angustifolius* et *nanus*, O. Kuntze, Revis. Gen. Plant. i. 178 (1891).

Canary Islands. Gomera: El Monte, Hermigua, *Lowe* 128.

Tenerife: El Monte Perexil, above Agua Mansa, 2000 m., *Lowe* 9; below Pedro-Gil, 1600 m., tree 20-25 ft. on bare slopes, *Dinn* 157; Santiago, *O. Kuntze*; Barranco de Montijo, 1000-2000 m., *Mann* 2514; "Mountain woods," *Masson* (type); *H. F. Talbot*; *Bourgeau* 51; 1306.

Vernacular "Escabon."

The type specimen was collected in 1778 by Francis Masson, the first collector sent out by Kew, and is at the Natural History Museum, South Kensington.

4. **Cytisus palmensis,** *Hutchinson*, sp. nov.; *C. proliferus*, var. *palmensis*, Christ in Engl. Bot. Jahrb. ix. 120 (1887).

Frutex laxe ramosus, usque ad 10 m. altus; rami elongati, foliati, breviter incano-tomentosi. *Folia* petiolata, trifoliata; foliola lanceolata, utrinque acuta, apice mucronata, 3-5 cm. longa, 0·7-1·4 cm. lata, tenuiter chartacea, supra primum debile et brevissime pubescentia, demum glabra vel subglabra, infra brevissime pubescentia; petioli 1-1·5 cm. longi, basin versus complanati, molliter tomentosi. *Flores* albi, in ramos breves axillares apice foliatos 3-4-natos dispositi; pedicelli graciles, 1-1·5 cm. longi, pilis longis et brevibus dense tomentosi. *Calyx* circiter 1 cm. longus, extra molliter pubescens, labio superiore breviter et acute bilobato, inferiore parum longiore acuto. *Vexillum* orbiculari-obovatum, breviter unguiculatum, fere 2 cm. longum et 1·4 cm. latum, apice minute emarginatum, dorso apicem versus leviter pubescens; alae oblique oblongae, apice rotundatae, uno latere auriculatae, ungue ciliato 5 mm. longo, lamina 1·5 cm. longa basin versus minute ciliata; carinae petala aliis simillima sed paullo breviora. *Tubus staminalis* 1 cm. longus. *Ovarium* pilosum, stylo curvato parce pubescente. *Fructus* oblongus, 4-4·5 cm. longus, 1-1·3 cm. latus, subappresse pubescens. *Semina* oblongo-ellipsoidea, 5 mm. longa, nigra, nitida, basi arillo crasso cupulare 1·75 mm. alto crenulato circumdata.

Canary Islands. La Palma: Borders of woods above the Barranco del Carmen, *Christ*; Dolores, *Christ*; La Banda, above Argual, at the foot of the cumbre towards the Caldera, *Lowe*; Lomo de Tagasaste, Caldera, *Sprague* and *Hutchinson* 436.

Vernacular "Tagasaste."

This plant is evidently confined in a wild state to the island of Palma, where it is extensively cultivated as a fodder plant (*vide supra*).

5. **C. stenopetalus,** *Christ* in Engl. Bot. Jahrb. ix. 162 (1887); Pitard et Proust, Fl. Canar. 151. *Teline stenopetala*, Webb. in Webb et Berth. Phyt. Canar. ii. 37 (1836-50). *Genista stenopetala*, Webb. l.c. t. 45. *Telinaria stenopetala*, Presl. Bot. Bemerk. 49 (1844). *Cytisus maderensis*, Briq. Les Cytis. des Alpes Marit. 137, partim (1894), non Masf.

Canary Islands. La Palma: Barranco del Rio, *Webb*; in the woods at El Monte de Barlovento, May, 1858, *Lowe* 342; between Garafia and Barlovento, Feb., 1888, *O. Kuntze*.

Gomera: El Monte, Hermigua, Apr. 1861, *Lowe* 117.

Hierro: Monte de Saviñosa, June, 1845, *Bourgeau* 90; El Golfo, May 1855, *Perraudiere*; *Lowe* 202.

Vernacular "Gacia."

Briquet (l.c.) says this species occurs in the Cape Verde Islands, but the writer has not seen any specimens from there.

VI.—SPARTINA AND COAST EROSION.*

Ida M. Roper.

An experiment is being tried in North Somerset to fight against the constant erosion of the coast line in the Bristol Channel where the conditions render it entirely different from what has been undertaken hitherto in other parts.

Here the spring tides rise regularly to 36 ft., and deposit on each occasion a considerable amount of mud right up to the limit of high water, but, on the other hand, scour away equally large quantities when the waves beat on the coast under the pressure of winter gales.

The Bristol Channel is full of long stretches of mud flats with deep water channels running amongst them. As the tides ebb and flow the edges of these flats are continually changed, and this applies equally to the long slopes of mud which are exposed at low water on the actual shore of the Channel. When these shore flats become lowered by the removal of their surface, the up-rushing tides, moving at times at five knots an hour over the ground, reach with increased force the earth-banks, which stand perpendicularly above the mud in varying heights from 2-20 ft.

This force of the tide eats into the bottom of the earth-bank, and with still more effect when the incoming tide is driven forward by a gale, with the result that the whole bank topples down on to the mud, and the tide can in this way get a few feet further inland.

This erosion has been going on for centuries; it has been slightly arrested by the coast lands rising a few feet in some parts of the Channel north of the Holm Islands, which stand across the Channel between Cardiff and Weston-super-Mare, but in other parts of the same stretch the destruction has been continuous, although at varying rates.

Nearly 150 years ago in this district the owners of the flats from Berkeley to the River Avon, with the help of Government, combined together, and went to the expense of building an earthen, and in some parts a stone bank some 10 ft. high all along the edge of the channel, a little distance above high-water mark. In this way they prevented specially high tides in combination with strong gales from washing away the surface of the neighbouring land, and they followed up this gain by a careful system of drainage, which enabled them to sow grass and convert the hitherto useless marsh into valuable pasturage.

In course of years similar extensive works were carried out both higher up the Severn and lower down as far as Bridgwater, at those parts where such sea-banks could give protection to the land behind.

This system of guarding the land answered very well, although a certain amount of ground between the sea-bank and high-water mark was being constantly eaten away by exceptionally heavy

* For previous accounts of *Spartina*, see *Kew Bull.* 1907, p. 190; *Stapf* in Gard. Chron., ser. 3, xliii. (1908), p. 33, and in Proceed. Bournemouth Nat. Sc. Soc. v. (1914), p. 76-82, pl. i-iii.

Sherring in Proceed. Bournemouth Nat. Sc. Soc. iv. (1913), p. 49, pl. i, ii.

weather. But that had been foreseen, and the land being of little value for feeding purposes, because of the large quantity of salt contained in the soil, the owners allowed it to go on unchecked. In other parts of the kingdom, however, the losses of valuable land from similar causes had become so serious that about 1907 Government appointed a Royal Commission to enquire into the facts and to suggest remedies. It was then urged that much good might be done to lessen, and possibly to stop, coast erosion by planting certain sand- and mud-binding plants, which might, by their numerous roots, bind together either the sand or mud and prevent erosion by the waves, and later on, by the great increase in their growth, raise the level of the ground gradually out of the reach of all such scouring action.

Spartina was among the grasses recommended to be planted as specially suitable where soft mud forms the only protection against erosion for the adjoining earth-banks; and as these are the conditions met with on the shores of the Severn in North Somerset, the planting of this particular grass became of special interest to the landowners of the neighbourhood.

Spartina Townsendi, the hybrid between *S. stricta* and *S. alterniflora*, which now covers thousands of acres of mud-flats in Southampton Water and Poole Harbour, is the one which has been planted in North Somerset. It is a vigorous stiff grass, reaching usually $2\frac{1}{2}$ ft. in height, with rigid leaves, long and pointed, standing off at an angle of about 60°. These rigid outstanding leaves are characteristic features, and easily distinguish it from the other two kinds. The stems and leaves are coloured a bright green when young, but turn in autumn to a brown hue with a beautiful golden sheen resembling ripe corn. On top of the solitary stem are the flowers in a stiff, branched spike growing at one side only of each branchlet. The spreading of *Spartina* to new areas and distant parts is mainly due to the dispersal of seeds; but as soon as it has established itself in an area, the covering over of the area by the closing up of originally isolated patches proceeds much more by stolons than by the interpolation of seedlings, chiefly because seeding is very irregular, and in some years almost nil. The underground stolons root at the nodes, and give rise to new plants. This method of growth causes the grass to form circular tufts, which go on increasing to many feet in diameter, until the spreading brings them in contact with other similar tufts, when the two join, and so produce large masses of closely interwoven roots to bind the mud together. Thus, in a few years regular fields or " meadows " of the grass appear where the mud had been in undisputed possession.

It will be observed that soft mud has played a very important part in the spread of the grass, because it is able from its nature to flourish in such mud when there is not too much sand present, and where practically no other plants are able to establish themselves in competition. It cannot grow apparently everywhere where such soft mud exists, as the plant will not survive being constantly covered by salt water; it will flourish when covered

by 2½ ft. of water at ordinary high tides, but its growth appears to be checked nearly completely if the depth exceeds 3 ft., whilst in shallower waters nearer the land it will put up with every hardship. Hitherto the growth of this particular species in England has been in quiet waters away from strong tides and the beating of heavy waves, and it may prove that such backwaters and river estuaries are its abiding home.

It will thus be evident that a plentiful growth of *Spartina Townsendi* on a bare expanse of soft mud daily washed by a moderate tide is capable of converting quickly such mud-flats into dry land and raising them above the level of ordinary tides. Should it prove capable of doing similar useful work in the presence of strong tides, a great help will have been obtained to check the constant washing away of muddy shores, and the growth of the grass would in course of time form a raised barrier protecting the adjoining earth-banks from erosion by the waves.

This is the experiment that is being tried on the coast about three miles south-west of Clevedon, North Somerset, and there *Spartina Townsendi* has been deliberately planted to test whether it be possible to overcome the strong tidal currents of the Severn, and the very heavy waves which beat upon the shore whenever the prevalent south-west winds blow strongly.

Special visits have been made to the spot this autumn to examine the results, and it is very interesting to find that the grass appears to have established itself with success, although the conditions are so different from those of the quiet estuaries of the English Channel.

It may be well to mention a few particulars of the conditions prevailing on the land below Clevedon between the estuaries of the rivers Kenn and Yeo, and the accompanying map will make these clear.

Inland there are fields (F), approached by a lane, protected by two lines of sea banks (O, I), the two barriers being built to make sure that if the front one is broken through by the force of the strong waves that beat in at that particular part, the water shall not be free to flood hundreds of acres of grassland that lie behind at only a few feet above the level of high-water mark.

Outside the front sea-bank is a flat stretch of grassland, called saltings or salt-marshes (E), in parts raised some 20 ft. straight up above the mud, and in others much less; very narrow in their width, and constantly becoming narrower by the erosion of the waves and tide. In fact, it looks as if all this salting would have disappeared by this time had not the authorities put in stretches of stone-facing to the earth-bank at the weakest spots.

By the River Yeo, at the south-west end, the erosion since the Ordnance map was issued in 1904, has been particularly severe, so that what is there represented as saltings is now soft mud about 3 ft. lower and reaching nearly to the sea-bank, with *Spartina* growing upon it some 30 yds. out to sea.

Seaward there is a stretch of soft sticky mud some 600 yds. in width, extending to low-water mark, and the object of the experiment of planting *Spartina* was to find out if it would grow on the mud in sufficient masses to check the force of the waves

Kingstone Pt
RIVER KENN
Saltings
Sea Wall
Farm
MUD
Low Water Mark of Ordinary Tides
Stones
Stone
LANE
Broadstone Court
Stones
Stone
Saltings
Mud
RIVER YEO
Scale 1 Inch = 1 Mile
N

from further eating away the saltings, already so nearly destroyed.

It is apparent at once that success is likely to attend the trial. There are sure signs of a vigorous and healthy growth of the grass, as the dots on the mud (S) show that it has already obtained a good foothold. The circular tufts are becoming much larger, and, whilst coming close together in some parts, are in others arranging themselves into miniature meadows across the run of the tide.

The number of tufts amount to several thousands, and as the mud is continuous into the bank they can send up new plants by means of their far-reaching runners or stolons. It is noticeable that the outermost tufts run in a nearly straight line, and this probably marks the spot where the mud is covered at ordinary tides by 2 to 3 ft. of water, and left dry again after a short time of immersion. The distance of this line is from 50 to 100 yds. out from the sea-bank (O). At one part, about one-third of a mile in length, no tufts of grass appear to have taken root, and this is no doubt a spot where the beating of the waves during rough weather is particularly strong, since the sea-bank on the shore opposite this stretch has been breached recently by heavy waves (B), and the path along it cannot at present be used.

This arrangement of the *Spartina* tufts in lines parallel with the shore is very noticeable at present in three small bights, where the rush of tide may be slightly checked by the intervening headlands, and a similar arrangement has been observed to occur in the quieter waters of the English Channel; but what is particularly interesting is the arrangement at the outermost belt, and it may be that the depth of mud rather than the height of the tide is the determining factor for the vigorous growth of the grass.

Four years ago the landowner, Mr. A. E. Clothier, of Keynsham, obtained a quantity of *Spartina Townsendi* from Hayling Island, which he had split up into one thousand small tufts consisting of two or three plants in each, and these were planted by the Warden one yard apart in a straight line in the mud close against the upright earth-bank of the saltings. The waves, however, promptly floated them all out, and deposited them 40 or 50 yds. to seaward. There most of them fortunately took root, and gradually settled down in a more or less straight line opposite the place where they were originally planted, with many of them shifted nearly half-a-mile northwards.

It was further stated that in about the year 1900 there was over 6 ft. of mud on this shore lying upon a layer of peat 4 in. thick, under which is found a bed of white clay, but by 1917 the mud was only 6 in. deep on the same spots (T). It would seem that on such thin mud close into the bank it was not a good place to plant the *Spartina*, but it is remarkable and novel that the tufts should be able to re-arrange themselves some way further out where the conditions were more favourable.

To illustrate further the scouring away of the shore it was learnt that in the three bights mentioned the earth-banks had been faced with carefully placed stonework, which for some years

past had to be constantly extended in length, and more often had to be underpinned with additional stones. Only this past summer at one spot 1½ ft. of underpinning had been put in, and within six weeks the operation had to be repeated, because the scour had taken away the supporting mud beneath for a depth of some additional 18 in.

The little tufts have increased greatly in number and have grown remarkably in size, many of them, after four years' growth, being more than one yard in diameter and forming many offshoots. Scarcely any of the tufts, however, have so far had time to grow sufficiently large actually to join together, and all of them in their present position are covered by a foot or two of water at each tide for one or two hours. If the present rate of growth continues with equal rapidity the mud will soon be clothed with a dense vegetation, and, to judge by the inspection of one of the present tufts, the hitherto soft mud will afford sufficient support for a man to stand upon the ground without making more than a footmark.

The numerous stems keep back amongst them during each immersion a small quantity of mud and silt, which serves to raise the ground, a little being held by the roots and stems, and at the same time a certain amount of sand brought in with the tides is left on top, which still further solidifies the mud.

Four years is a very short time to watch such changes, and it will be interesting to see whether *Spartina* can hold its own against the force of the waves, and increase in sufficient quantity to render their action of small account after they have travelled across the thick growth to the foot of the saltings. Should the force of the waves be broken at this spot, the experiment will have been a success, and it may be anticipated that a further growth of the grass will line the foreshore with a stretch of firm ground that will protect the sea-bank more effectually than was done by the original saltings when they were left outside for that purpose.

VI.—MISCELLANEOUS NOTES.

Worthington G. Smith.—It is with much regret that we record the death of Worthington G. Smith, which occurred at Dunstable on 27th October, 1917. To readers of the *Gardeners' Chronicle*, Mr. Smith was best known as a botanical artist, and the clear, forcible illustrations initialed with the familiar "W. G. S." appeared regularly for a period exceeding 40 years. He was, however, in addition, an antiquarian, and a well-known mycologist. His drawings of plants were characterised by firmness and attention to detail, and, as may be seen from the magnificent series of coloured drawings in the public galleries of the British Museum, his fungus drawings were of the highest order. Though not in very close touch with Kew, he was keenly interested in the new British fungi described by the Herbarium staff, and always anxious to learn the distinguishing features with

a view to obtaining a figure for his own series of drawings of British fungi.

Worthington Smith was born in 1835, and was a contemporary of Berkeley and Cooke; by his death, therefore, mycologists are deprived of a most interesting link with the past. His principal published works were:—*Diseases of Farm and Garden Crops* (1884), a supplementary volume to Berkeley's *Outline of British Fungi* (1891), *Man, the Primeval Savage*, and the well-known and useful *Synopsis of British Basidiomycetes* (1911). Amongst other awards received for his work as an artist was the Gold Medal of the Royal Horticultural Society, and the Silver Medal of the R.H.S. of Ireland. In 1865 he was awarded the Knightian Medal of the former society for his researches on Potato Blight; the results of this work, however, have not been altogether accepted by later botanists. Worthington Smith was the first freeman of Dunstable, and was President of the British Mycological Society in 1903. He was awarded a Civil List Pension in 1902 for his services to archaeology and botanical illustration. A. D. C.

Edward John Woodhouse, Lieut.—We record with regret the death, from wounds received in action in France, of Lieut. E. J. Woodhouse, M.A., F.L.S., Economic Botanist and Principal of the Agricultural College, Sabou, Bihar and Orissa, which occurred at a Casualty Clearing Station in France, on December 18th, 1917, aged 33.

In October, 1907, he was appointed Economic Botanist to the Government of Bengal, and proceeded at once to India. After three years' work there he was made Principal of the Agricultural College of Bihar and Orissa, retaining his other appointment. By a successful invention for the treatment of a pest in his province, he saved his Government in one year between four and five lakhs of rupees. At the outbreak of war he was a captain in the Bihar Light Horse. After repeated applications he was allowed to join the Indian Army Reserve of Officers, and in February, 1915, was attached to a cavalry regiment on the N.W. Frontier. In the following July he went to France, where he was attached to another cavalry regiment and became signalling officer, acting adjutant, and officiating squadron commander.

A. H. Hildebrand.—It is with much regret that we learn of the death of Mr. Arthur Hedding Hildebrand, C.I.E., which was announced in *The Times*, of January 7th. Though best known for his administrative work in Burma, where he spent more than 30 years of his life, and where, between the years 1891 and 1902 he was Superintendent and Political Officer of the Southern Shan States, he will be remembered in the horticultural world as the introducer of several plants which have been of more than ordinary interest. These, in most cases, were sent to Kew, with which Mr. Hildebrand commenced to correspond in 1891 in consequence of a request having been sent to him by the Director for seeds of the remarkable *Lonicera Hildebrandiana*, Collet & Hemsl., which had been described shortly before. Mr.

Hildebrand experienced some difficulty in procuring seeds of this plant owing to the fact that its fruits, which are nearly as large as a walnut and have a sweet pulp, are eaten by rats, squirrels and birds. However, he at length succeeded in getting some seeds which were received at Kew in September, 1892, but these failed to germinate. From a consignment received in September, 1893, some plants were raised, and in January, 1894, a Wardian case containing 49 seedlings of the *Lonicera* reached Kew, from which some were distributed to various establishments, including the Royal Botanic Gardens, Glasnevin, where the plant first flowered in August, 1898. In 1899 a plant flowered in the Temperate House at Kew, and material obtained from this was used in the preparation of the plate in the *Botanical Magazine* (t. 7677). *Lonicera Hildebrandiana* was afterwards discovered at Mengtze and Szemao in Yunnan, by Mr. Augustine Henry, but in the Chinese specimens the corolla is rather shorter than in the Burmese. It is only in very favoured localities, such as Cornwall, that this honeysuckle will thrive out-of-doors in these islands, and only a greenhouse of large dimensions will accommodate so robust a grower. It is, therefore, never likely to become a popular plant. This remark applies still more forcibly to *Rosa gigantea*, Collett (*Bot. Mag.* t. 7972), which, though introduced into this country some years before Mr. Hildebrand commenced his correspondence with Kew, was the subject of some interesting comments in his letters. We learn from these that in Burma the rose sometimes forms a bole as thick as a man's thigh, and its stems overtop trees 60 to 80 ft. high, when, its branches hanging from the tree-tops, it blossoms profusely, its flowers appearing as a sheet of white and filling the air around with a delightful fragrance.

Amongst other plants sent to Kew by Mr. Hildebrand were *Bulbophyllum comosum*, Collett & Hemsl. (*Bot. Mag.* t. 7283), originally introduced into this country by Colonel Sir H. Collett in 1889; *Aeschynanthus Hildebrandii*, Hemsl. (*Bot. Mag.* t. 7365), and *Orchis monophylla*, Collett & Hemsl. (*Bot. Mag.* t. 7601). Perhaps his best introduction was *Dendrobium Hildebrandii*, Rolfe (*Bot. Mag.* t. 7453), which he sent to Messrs. Hugh Low & Co., of Clapton, who forwarded plants to Kew. This is a handsome and remarkably floriferous species allied to *D. tortile*, Lindl., with light yellow flowers, or, in the variety *oculatum*, with two maroon blotches on the disc of the lip. It is a parent of several interesting hybrids, including *D. Elwesii*, *D. Ellisii* and *D. Haywoodiae*.

In addition to various other plants Mr. Hildebrand sent to Kew seeds and a large number of bulbs of *Lilium sulphureum*, Baker, *L. Lowii*, Baker, and *L. Bakerianum*, Hemsl. & Collett. He was anxious to experiment in Burma with the cultivation of English garden roses and strawberries and a collection of plants of the former and seeds of several kinds of strawberries were sent to him from Kew.

Mr. Hildebrand retired in March, 1902, and returned to his English home at Devizes, Wiltshire. He died at Puddletown, near Dorchester, at the age of 65. S. A. S.

Additions to Gardens.—The war continues to affect the exchange, etc., between Kew and other botanical establishments. Of the comparatively few consignments of material sent from Kew to oversea institutions a few were lost in transit. This was also the fate of some consignments from abroad intended for Kew. Notwithstanding these difficulties, many consignments of seeds and a few living plants were received from botanical and other institutions all over the world. The principal receipts during the year were:—

Botanic Gardens and other institutions:

Loanda, Angola—Seeds of Palms and various plants of economic interest.

Arnold Arboretum—Many packets of seeds.

South African Department of Agriculture, Pretoria—Various seeds, tubers and plants, including Teff grass (*Eragrostis abyssinica*).

Giza, Department of Horticulture, Cairo—Various seeds, including *Hyoscyamus muticus*, *Ilex paraguayensis* and *Hyphaene thebaica*.

Dunedin Botanic Garden—Seeds of Celmisias and other New Zealand plants.

Hong Kong Botanic Garden—Seeds of *Rhodoleia championi*, *Tutcheria spectabilis*, *Strychnos angustiflora*, and *Momordica cochinchinensis*.

United States Department of Agriculture, Washington—Various trees and shrubs.

Singapore Botanic Garden—Various seeds, including *Hyphaene indica*, *Styrax benzoin*.

Greenwich Park (Mr. T. Hay)—*Gentiana Farreri*, *Meconopsis decora*, etc.

Honolulu, Board of Agriculture and Forestry—Seeds of Palms, etc.

Calcutta Royal Botanic Garden—Various seeds.

Khartoum, Department of Agriculture and Forests—Seeds of *Hyoscyamus muticus*.

Trinity College Botanic Garden, Dublin—*Amorphophallus Kerrii*.

National Botanic Garden, Kirstenbosch, Cape Town—Seeds of South African plants.

Trinidad Royal Botanic Garden—Cacti from Patos Island.

Director Agricultural and Commercial Services, Saigon, Cochin-China—Seeds of *Strychnos Nux-vomica* from wild plants in Cochin-China.

Uganda Protectorate, Forestry Department—Seeds of *Carapa grandiflora*, etc.

Dominica Botanic Garden—Tubers of Yams and Aroids.

Royal Botanic Garden, Edinburgh—New species of *Primula* from China.

Kumaun Botanic Garden—*Anoectochilus* sp.

Receipts from other sources included the following:—

Mr. F. Nutter Cox, San José, Costa Rica—Seeds of an indigenous cotton, believed to be a new species.

Mr. M. T. Dawe, Director of Agriculture, Colombia—Seeds of rare and new plants, including *Befaria* sp. and *Cactaceae.*

Mr. H. J. Elwes, Colesborne—Various plants and seeds.

Miss A. Balfour—Seeds of *Eucalyptus whittingehamensis.*

Countess of Selborne—Seeds of *Meconopsis* from Sikkim.

Messrs. Singlehurst and Co.—Seeds of *Cybistax antisyphilitica* from Bolivia.

Mr. J. C. Williams, Caerhays—Chinese Rhododendrons and Primulas.

Dr. G. V. Perez, Teneriffe—Seeds of Palms, Pines, Echiums and Cytisi for distribution.

Prof. A. Henry—Seeds of *Picea sitchensis, Larix alaskensis* and *Cedrus brevifolia.*

Mr. N. E. Brown, Kew—Stapelias, Mesembryanthemums, etc.

Mr. A. Jackson, H.B.M. Consul, Madrid—Seeds of five species of Junipers from Madrid and Valencia, for distribution. Collected by Mr. Alfred Martinez, of the Forestry Board, Madrid, and Mr. Rafael Janini, Agricultural Engineer, Valencia.

Hon. Vicary Gibbs, Aldenham—Various trees and shrubs.

Capt. J. Bush, Chatham—*Pelargonium Cotyledonis* from St. Helena.

Mr. R. Vallentin, Falmouth—Ferns from the Falkland Islands.

M. Vilmorin, Paris—Hybrid *Columnea.*

Mr. C. U. Stuart, Alaska—Seeds of native shrubs, etc.

Mr. H. Clinton Baker, Bayfordbury—Conifers.

Mr. W. Cooke, Colombia—Seeds of *Posoqueria Cookei*, etc.

Mrs. Longstaff, Wimbledon—Seeds collected in Yassin, etc.

Mr. E. H. Wilding, Stoke Poges—*Rhododendron maximum.*

Mr. W. Greenwood, New South Wales—Various seeds.

Mr. R. H. Beamish, Cork—*Corylus thibetica.*

Miss E. Willmott—Paeonias, etc.

Mr. W. R. Dykes, Godalming—*Iris Wattii.*

Mr. P. D. Williams, St. Keverne—*Primula Maclareni.*

Mr. R. Farrer, Lancaster—Collection of Chinese Plants (52 species).

Mr. W. A. Milner, Sheffield—*Primula Reidii.*

Mr. S. W. Damon, Argentine—Seeds of *Ilex paraguayensis* var.

Mr. A. C. Butter, Stellenbosch—Seeds of *Telfaria pedata.*

Miss P. Wake, Northampton—A large *Platycerium.*

Lieut.-Col. F. R. S. Balfour, Dawyck, N.B.—Various seeds.

Mr. A. E. Felton, West Falkland—Seeds of *Calandrinia Feltoni.*

Prof. O. Beccari—Seeds of *Copernicia australis.*

Sir E. G. Loder, Bt., Leonardslee—Various trees and shrubs.

Capt. G. H. Johnston, Trewithan—Seeds and bulbs from Palestine.

Mr. G. W. E. Loder, Ardingly—Various trees and shrubs.

Mr. C. D. Graham, Kildare—Seeds from Macedonia.
Mr. G. Elisha, Canonbury Park—Mesembryanthemums.
Mr. T. H. Burroughs, Stamford—Various trees and shrubs.
Prof. J. H. Wilson, St. Andrews—Hybrid Passifloras and Begonias.
Mr. A. Monk, New Jersey—Seeds of *Gentiana crinita*.
Sir F. Crisp, Bt., Henley—Various economic plants and palms.
Major Howard, Richmond—Seeds from Kilamatende, East Africa.

Among the purchases made were specimen Filmy Ferns, from Mrs. Waterhouse, Halifax, and seeds of *Pouteria suavis* and *Ilex paraguayensis* from Mr. E. Frosio, Uruguay.

Surplus plants were distributed to various botanic gardens and public parks, and there was the usual distribution of seeds that had been saved during the year from the cultivated plants in the gardens. The total number of packages thus distributed was 966 hardy herbaceous, and 689 hardy trees and shrubs.

The most important of the seeds specially distributed were those of *Hyoscyamus muticus*, which yield Hyoscyamine of commerce; *Ilex paraguayensis*, which yield Paraguay tea; *Clematis Stanleyi; Pouteria suavis;* "Teff", (*Eragrostis abyssinica*); *Befaria* sp. from Sierra Nevada; Juniper seeds from Spain and seeds of Cytisi and *Pinus canariensis* from Teneriffe.

A number of plants raised for British Military Cemeteries in France, including 250 Eucalypti, Canadian Maples, and other trees and shrubs were sent to the Director, Graves Registration and Enquiries, G.H.Q., France.

During the year a number of nursery borders and some flower beds in the public grounds were devoted to the cultivation of vegetables, such as potatoes, turnips, parsnips, cauliflowers, cabbages, carrots and leeks.

Arboretum.—The difficulties arising from the shortage of labour, to which reference was made a year ago, have, as was only to be expected in present circumstances, increased during the past twelvemonths. As regards cleanliness and order they have indeed proved cumulative, owing to the impossibility of preventing the seeding of weeds during the last two summers. But weeds, however unpleasant and unsightly they appear, may we hope, be regarded as a temporary evil. Our chief aim must be to keep intact the magnificent collections of living plants which have been got together with such an expenditure of time, labour and money.

The grass on many of the lawns, in normal times kept closely mown, was left to grow, thereby contributing to the large stack of excellent hay which, in spite of the dryness of the early summer, was secured.

Little damage has been done by storm during the past year as compared with 1916, but two fine trees were destroyed by lightning—one a large sweet chestnut near the North Gallery, the other a common oak near the Azalea Garden. The first was barked so thoroughly that it died by autumn, whilst the trunk

of the latter was split to the very base. A spreading beech of huge dimensions near the Oxenhouse Gate was so badly wrecked by wind that it had to be removed. It was no doubt one of the comparatively few beeches that remain of the Richmond Gardens of Queen Caroline's time.

The Chinese barberries introduced by Messrs. Wilson and Forrest are so numerous and have grown so well that it has been found necessary to enlarge the area devoted to the Natural Family to which they belong. Fresh ground has therefore been taken for them on the northern slope of the Flagstaff Mound. These new barberries are proving very ornamental in their fruits, and will certainly be valuable acquisitions among hardy trees and shrubs.

The semi-oval plot of ground on the north side of King William's Temple has been re-laid out. It is proposed to plant here shrubs of exceptional interest or delicate growth. In many Natural Families there are species too small or not sufficiently robust to hold their own against the average run of their allies—such for instance as *Pachystima Canbyi*, *Ilex Mariesii*, *Rhododendron Williamsianum* and *R. flavidum*. These, and others of a similar class, can here be given special care and kept free from the encroachment of greedy neighbours.

At the request of the military authorities the Assistant Curator has visited parts of the coast to advise on the planting of sand dunes and for purposes of camouflage; also as regards planting for shelter and ornament near new residential quarters being erected by the Admiralty.

Very few additions of living trees and shrubs have been made, but acknowledgments are due to several amateurs who have contributed new species, especially to Mr. J. C. Williams, the Hon. Vicary Gibbs, and Mr. Reginald Farrer. One consignment only has been received from overseas, viz., some new plants, mostly of Chinese origin, from the U.S. Dept. of Agriculture.

Donations of trees and shrubs have been made to the following public institutions:—Unemployment Insurance Buildings, Kew; Queen Alexandra's R.C. Hospital, Glengariff; R.F.C. Aircraft Park, Bristol; British Military Cemeteries in France.

The following new rhododendrons have flowered for the first time at Kew:—*R. adenopodum*, *R. hippophaeoides*, *R. oleifolium*, *R. polifolium*, *R. prostratum*, and *R. Sargentianum*. The remarkably late flowering *R. auriculatum*, which first blossomed at Kew in 1916, did so again in July, 1917, and much more freely than before. W. J. B.

Museums.—In the past year the additions to the permanent collections have been few in number, consequently the duplicate material for distribution has been limited. A large number of miscellaneous products have been received for determination from Government Departments, scientific institutions, commercial firms and private individuals, and much general information has been supplied in this direction. Many of the

enquiries dealt with were of a confidential character; the chief products not confidential as to which information has been given have been foods, food grains, oil seeds, medicinal plants, timbers, fibres, and dyes. Considerable progress has been made in generally improving the collections, and over two thousand freshly-printed labels have been attached to the collections in Museum No. 1. The buildings that are closed, due to depletion of the staff, have in all cases been made available to visitors desiring to examine the collections for special purposes or for general study. J. M. H.

Presentations to Museums.—The following miscellaneous specimens have been received in addition to those previously recorded in the *Bulletin*:—

Crown Agents for the Colonies.—Sample of Cocoa from the Cameroons.

Director, Botanic Gardens, Singapore.—Sections of wood of *Rhodamnia trinervia*, *Cupania pallidula* and *Elaeocarpus Hullettii*.

Dr. Perez, Santa Ursula, Tenerife.—Roots and pieces of trunks of *Convolvulus scoparius*.

Mr. M. T. Dawe, Director of Agriculture, Colombia.—Specimens of native wood carving, seeds of Ivory Palm (*Phytelephas macrocarpa*), bark and resin of *Cercedium spinosum*, pods of Divi Divi (*Caesalpinia coriaria*), etc.

Mr. J. S. Gamble, F.R.S., East Liss, Hants.—Seven small samples of Mahogany.

Mr. S. W. Damon, Orán, Argentine.—Pods of Algarrobo blanco and of Algarrobo negro (*Prosopis juliflora*, var.), fruits of Mistol (*Zizyphus Mistol*), also fruits and seeds of Chanar (*Gourleia decorticans*).

Private C. C. Pemberton, Canadian Reserve Battalion.—Twelve photographs of root and branch grafting in British Columbia.

Mr. G. M. Ryan, F.L.S.—Series of photographs of the Mahwa tree (*Bassia latifolia*), India.

H.M. Consul, Costa Rica.—Fruits of the Balsa tree (*Ochroma lagopsus*).

Mr. Cecil Brown, Kew.—Gnarl on *Cedrus Libani*.

Sir E. G. Loder, Bart., Horsham, Sussex.—Cluster of cones of *Pinus*.

Mr. T. Drewry, Forest Gate, Essex.—Section of a pile of Ballah wood (*Shorea collina*?) bored by teredo, drawn up in Keppel Harbour, Singapore, 1907.

Mr. E. R. Pratt, Downham, Norfolk.—Planks of *Abies Nordmanniana*, *Cupressus Lawsoniana*, and a transverse section of *Picea excelsa*.

Mr. F. G. Walsingham, Assistant Director of Horticulture, Cairo.—Fruit of Doum Palm (*Hyphaene thebaica*), Egypt.

Mr. W. G. Wallace, Boscombe, Hants.—Two samples of Curare poison from the Amazon Valley.

Mr. C. U. Stuart, Seattle, U.S. America.—Fruits of *Viburnum pauciflorum* from Alaska.

Mr. A. Waterer, Knap Hill Nursery, Woking.—Fruits of *Corylus Colurna*.

The Hon. Vicary Gibbs, Elstree, Herts.—Paper manufactured from *Populus deltoides*.

Mr. F. D. Harford, C.V.O., Henbury, Bristol.—Photograph of a tree of *Ginkgo biloba* growing in the grounds of Blaise Castle. Height 70 ft., girth at 4ft. 6 ins. from the ground 10 ft. 3 ins.

Mr. H. C. Baker, Almondsbury, Gloucester.—Fruits of *Akebia quinata* and of *A. lobata*.

Messrs. F. W. & E. Bloore, Timber Merchants, Ferndale Road, Clapham.—A finely figured slab of Mahogany.

Messrs. Wigglesworth & Co., Fenchurch Street, London.—Sample of Flax (*Linum usitatissimum*), from British East Africa.

Mr. H. Kempshall, Abbotsbury Gardens, Dorchester.—Section of stem of *Acacia dealbata*.

Mr. C. Warren, Curator, Agricultural Department, Nigeria.—Abnormal fruit of *Cocos nucifera* and a cake of Camwood prepared from *Baphia nitida*, at Banoara, Southern Nigeria. J. M. H.

Research in Jodrell Laboratory in 1917.—Mr. J. Bintner continued his observations on the development of callus-tissue and the formation of roots in cuttings, and began a study of some galls on the stem of one of the *Proteaceae*.

Mr. L. A. Boodle studied some of the properties of charred wood, and was engaged in anatomical work of various kinds.

Mr. A. Sharples began an investigation of *Hevea*-wood attacked by *Ustulina zonata*.

Mr. W. C. Worsdell examined the comparative anatomy of *Compositae*, *Polygonaceae*, etc.

Pathological Laboratory.—A special feature of the season 1917 was the marked increase of interest in fungus and insect diseases of plants, and the recognition by a large body of the public of the amount of damage which various plants pests are capable of inflicting.

In some of the southern and south-west districts bad attacks by caterpillars on fruit trees in the spring, severe scabbing of the fruit later, and extensive outbreaks of potato blight caused very considerable losses, and large growers and market gardeners as well as amateurs appealed for advice and for better methods of control, both by letter and by visits to the laboratory.

With regard to the staff, Mr. W. B. Brierley was absent on military duty from 6th January to the end of March. Mrs. N. L. Alcock was appointed permanent assistant, and has been engaged particularly on diseases of fruit trees. Miss M. N. Owen was appointed temporary technical assistant in January.

I.—Advisory Work.

Some 800 enquiries were received through the post, which represents an increase of nearly 300 over 1916. 99 different kinds of disease were represented, including 14 diseases of potatoes, 12 of apples, and 10 of cereals. Since the middle of August numerous questions relating to diseases received by the Food Production Department have been sent to Kew for reply.

In the spring many samples of seed potatoes were received and questions as to the desirability of planting those affected by dry rot, blight, and scab were replied to. Some 20 samples were affected by *Spicaria solani* which caused spots and markings similar to blight and has been often confused with it. The fungus causes very little damage, and it was recommended to plant the affected tubers even though they had in some cases been previously condemned.

The usual common diseases appeared as the season advanced, though American Gooseberry Mildew was conspicuous by its absence, and Whiteheads in Wheat was apparently less destructive than last year. A large amount of browned and scorched potato foliage was received for report, but it was not always possible to diagnose this satisfactorily owing to lack of opportunity for field investigation. Amongst the most prevalent diseases in 1917 were:—Black Currant Rust, Bean Pod Canker, Black Leg of Potato, Potato Scab on newly-broken ground, Plum Rust, Die Back of Apples, Onion Diseases (*Sclerotinia* and *Botrytis*) and Sooty Blotch of Apples.

Special mention should, however be made of the following:—

Black Currant Rust. (*Cronartium ribicola*).—Attention was called to this disease early in the year owing to legislative action by the United States of America. At the time the Black Currant Rust was supposed to be rare and local, and a memorandum was sent to the Board of Agriculture to this effect. The rust, however, was discovered in several districts about the middle of July, and by the end of the summer the disease was general throughout the whole of the southern counties, and extended as far north as Norfolk. In some cases it was extraordinarily abundant and caused severe defoliation. No outbreaks occurred at Ealing, Hounslow, or Kew, due perhaps to these districts being within the range of London smoke. The aecidiospore stage of the disease is very destructive to Weymouth Pine, and a report of the spread of the fungus in Britain in 1917 was submitted to the Board on October 27th. The outbreak serves to show how a disease may suddenly become epidemic after having existed in a country for many years in scattered localities. The appearance over so wide an area in 1917 suggests, however, that owing to the lack of an adequate phytopathological service the fungus had spread unnoticed during previous seasons.

Onion Disease.—In addition to suffering from *Botrytis* and Mildew, reports were received from several quarters that the onion crop was being badly attacked by a species of *Sclerotinia*. This disease, though long known, has never been properly

investigated, neither had the species been correctly determined. The fungus has been isolated, and it is proposed to work out its life-history, whilst Mr. Brierley will investigate the *Botrytis* with which it is often accompanied. The whole question of the diseases due to *Sclerotinia* and *Botrytis* is urgently in need of thorough investigation.

II.—Research.

American Gooseberry Mildew. (*Sphaerotheca mors-uvae*).—In continuance of the work on the dehiscence of the perithecia and the vitality of the spores of *Sphaerotheca mors-uvae*, on which a report was drawn up last year by Mr. Cotton and Mrs. Alcock, a number of bushes were planted in the Experimental Ground, and much material was collected. The mildew, however, did not appear, and was completely absent in this neighbourhood in 1917.

Parsnip Canker.—This research was undertaken in response to enquiries from the Evesham growers last January, who stated that hundreds of tons of roots were being lost in their district. The work was carried out largely at Kew, and an account of the disease will be found in the current number of the *Bulletin* (see p. 8).

Wart Disease.—Owing mainly to the exigencies of the War and absence of inspectors this disease has spread very seriously in many parts of England, and through the distribution broadcast of contaminated seed it may be expected to appear even more widely in the near future. The absolute immunity of certain varieties is a piece of sheer good fortune which has saved the country from a very grave situation. The matter should not, however, be left in this position, as immunity may suddenly break down. The life-history of the fungus requires further study, and the factors conferring immunity should be elucidated. It was hoped to carry out a joint research by Mr. Cotton and Mr. Brierley on the life-history of the parasite and on the conditions especially necessary for the germination of the spores and infection of the host. The results so far obtained have been conflicting and chiefly negative, and the work has had to be set aside. The problem is a large and important one, and a thorough investigation, along biochemical lines, is urgently needed, and should be made a whole-time study by a competent investigator. The small size of the Staff has hitherto prevented this from being undertaken at Kew, even were the locality suitable for the purpose.

A series of experiments, designed to show the amount of heat required to kill the resting spores was attempted in the yard attached to the laboratory, but owing to the controls becoming infected the results were vitiated. The yard arrears now to be thoroughly contaminated with wart disease spores.

Apple Mildew (*Podosphaera leucotricha*).—The research on this disease was concluded. It was found that perithecia-formation often took place in the older parts of the mycelium, but

in spite of this the ascospores are apparently of little importance in the life-history of the fungus, as it reproduces itself by means of hibernating mycelium. The disease, therefore, must be controlled by pruning, and not by spraying, though experiments conducted at Wisbech and elsewhere showed that the conidial stage of the fungus could be very materially checked by the use of a strong lime-sulphur wash. A paper on the subject will shortly be published.

Botrytis.—A comparative investigation of the morphology and parasitism of the fungus *Botrytis cinerea* has been carried out by Mr. Brierley, particularly in *Aesculus Pavia* and *Ribes alpinum*. An account of the behaviour of the fungus in the former will be found in *Kew Bull.*, 1917, p. 315. In *Ribes alpinum* the fungus was found to be confined to the dead, water-conducting elements of the stem, and is present throughout the aerial portion of the plant, developing along with the host and existing in a symbiotic condition with its tissues. The host is stunted and stimulated to the formation of galls which morphologically are adventitious roots.

The results of an investigation of the morphological characters of *Botrytis cinerea* and their specific value will be published in the *Bulletin* in the course of the year.

Progress has also been made during the year in the investigation of *Thielavia basicola* and *Trichophyton crateriforme*.

The Experimental Ground.—A portion of the new ground acquired last year in place of the old plot has been laid out in beds and enclosed with fruit and other trees. Of the remaining portion a large part was used for the cultivation of potatoes and other vegetables. The laid-out portion is now stocked with a few specimens of the commonly grown market varieties of fruit, including special plots of gooseberries and black currants for experiments with American Gooseberry Mildew and *Cronartium ribicola* respectively. Observations were made during the past season on several potato and tomato diseases. Five plots were devoted to parsnip for work on Canker, and though fairly satisfactory results were obtained the sticky nature of the soil rendered it not particularly suitable for experimental work of this nature.

III.—Travelling.

Official visits were paid to the Wisbech district in connection with the spraying of apples for Apple Mildew and other diseases, and to Evesham and Worcester with reference to parsnip canker. Silver Leaf in plums, and obscure diseases of the potato. The spread of Weymouth Pine Rust was examined at Oxford, and visits were paid to Ormskirk and other localities in connection with Wart Disease and other maladies of the potato. A.D.C.

Presentations to the Library during 1917.—Prof. C. S. Sargent, Director of the Arnold Arboretum, has continued to send to Kew the official publications of the Arboretum, and these

of 1917 include *The Conifers and Taxads of Japan*, by E. H. Wilson, and the final part of *The Plantae Wilsonianae*. The last-named work is in nine parts, forming three thick octavo volumes, comprising altogether nearly 2000 pages. Among Prof. Sargent's other presentations is a copy of *Color Standards and Color Nomenclature*, by R. Ridgway.

Prof. Hans Schinz has sent No. 76 of the *Mitteilungen aus dem botanischen Museum der Universität Zürich*. From the Conservator of Forests, Western Australia, have been received *A Discussion of Australian Forestry*, by D. E. Hutchins, and a third edition of *Western Australian Timber Tests*, 1906 (and supplement), by G. A. Julius; and from the Trustees of the British Museum, parts 1 and 2 of the *Botany of the British Antarctic Expedition*, 1910. These deal with the Algae.

Prof. L. H. Bailey's *Standard Cyclopedia of Horticulture* has been completed by the issue in June of the sixth volume, and the establishment is indebted to the author and the publishers, Messrs. Macmillan, for an entire set of this extremely useful work.

Dr. E. R. Prósper, of the Central University, Madrid, has published, in a handsome quarto volume, a work of much interest, entitled: *Dos noticias históricas del inmortal botánico . . . Don Antonio José Cavanilles por D. Antonio Cavanilles y Centi y D. Mariano La Gasca*, a copy of which he has presented to the library. In a letter to the Director, Dr. Prósper mentions that both A. J. Cavanilles and La Gasca belonged to the Linnean Society of London, and that when the latter, being persecuted in Spain on account of his political views, took refuge in London, he was kindly treated by celebrated English savants. He was a pupil of Cavanilles and eventually succeeded him in the chair of botany at Madrid, after spending about eleven years (1824-34) in England and Jersey. He died at Barcelona, June 23, 1839 (*Proc. Linn. Soc.*, vol. i. p. 71). Cavanilles, who was born at Valencia, Jan. 16, 1745, and died at Madrid, May 4, 1804, was one of the original foreign members of Linnean Society (*Memoir of Sir J. E. Smith*, vol. i. p 347). The volume includes portraits of Cavanilles and La Gasca and numerous biographical notices of contemporary botanists.

Notwithstanding the extremely unsettled state of Russia there is evidence that some progress in botanical research has been made, and numerous publications have been received from Mr. Boris Fedtschenko, Mr. D. Janischewsky, Mr. H. A. Naumoff, and the Director of the Botanic Garden of Nikita, Yalta, Crimea. Mr. Fedtschenko's presentations include an illustrated Flora of Turkestan and the Kirghiz Steppes, and portions of a Flora of Asiatic Russia, both works being in Russian.

The second edition of the *Prodromus Florae Batavae*, published by the Netherland Botanical Society, vol. i. part 4 (Monocotyledons), has been received from the Secretary of the Society, and the four parts issued of the *Communications from the Netherland Government Institute for Advising the Rubber Trade . . . established at Delft*, have been received from the

Council of the International Association for rubber cultivation in the Netherland Indies.

Prof. E. D. Merrill, of the Section of Botany, Bureau of Science, Manila, has been engaged for several years on the study of Rumphius's *Herbarium Amboinense*, which had been begun by Dr. C. B. Robinson, whose lamented and tragic death occurred in Amboina on Dec. 5, 1913. Prof. Merrill has now published the result of his researches in a volume of 595 pages, entitled: *An interpretation of Rumphius's Herbarium Amboinense*, a copy of which he has presented to the library. In the course of his investigations, Prof. Merrill has discovered over a hundred names, a list of which appears in his work, which have been omitted from the *Index Kewensis*.

A large selection of the extremely useful publications of the United States Department of Agriculture has been received, as in former years, from the Secretary of Agriculture, Washington. Dr. N. L. Britton has sent the parts published during the year of the *North American Flora*, and the Director of the Department of Agriculture in the Dutch East Indies, the various publications issued under his direction. The Bentham Trustees have presented such of the periodicals and serials received in exchange for *Hooker's Icones Plantarum* that have been published and distributed.

The following have also been received: *Travaux du Laboratoire de Matière Médicale de l'École Supérieure de Pharmacie de Paris*, published under the direction of Prof. E. Perrot, vols. v.-x.; *A Contribution to the Phytogeography and Flora of the Arfak Mountains* (Dutch N.W. New Guinea), by L. S. Gibbs, and *The Australian Flora in Applied Art*, part 1, *The Waratah*, by R. T. Baker, from the Director, Royal Botanic Gardens, Kew; *A Record of Plants collected in Southern Rhodesia*, by F. Eyles, and other publications, from the Assistant Director; *Bibliographie des Travaux scientifiques...publiés par les Sociétés savantes de la France*, by J. Deniker, tome i. livraison 3, from the Director of the Natural History Museum, Paris; several memoirs on Palaeobotany, by E. W. Berry, from Mr. L. A. Boodle; *Farm Forestry*, by J. A. Ferguson, from the publishers, Messrs. Chapman and Hall; *Icones Plantarum Formosanarum*, by B. Hayata, vol. vi., from the Bureau of Productive Industries, Government of Formosa; *Gleanings in old garden literature*, by W. C. Hazlitt, from Miss M. Smith; *Vernacular list of Trees, Shrubs and Woody Climbers in the Madras Presidency*, by A. W. Lushington, from Mr. J. S. Gamble; *Specula physico mathematico-historica notabilium ac mirabilium sciendorum...*(Norimbergae, 1696), by J. Zahn, from Sir Frank Crisp, Bart.; and *Proceedings of the First Agricultural Conference, Malaya*, from the Director of Agriculture, Federated Malay States.

The more important of the publications added to the library as presentations from authors are:—*British Grasses and their employment in Agriculture*, by S. F. Armstrong, (from the author and the Syndics of the Cambridge University Press); *Trees and Shrubs hardy in the British Isles*, by W. J. Bean,

second edition; *Monographie du Genre Melampyrum, L.*, by G. Beauverd; *Marine Algae of the Danish West Indies*, by F. Börgesen, vol. iii. pp. 145-240; *La Fôret et les Bois du Gabon*, by Auguste Chevalier; *Descriptive list of Trees, Shrubs, and Economic Herbs of the Southern Circle, Central Provinces* (India), by H. H. Haines (from the author and the Secretary to the Commissioner of the Central Provinces); *Catalogue des Phanérogames de l'Argentine*, by L. Hauman and G. Vanderveken, and 3 pamphlets by L. Hauman; *The Trees, Shrubs, Herbs and Climbers of Sierra Leone*, by C. E. Lane-Poole (2 copies); *Los Poliporáceos de la Flora Española*, by B. Lázaro é Ibiza; *Bitter Pit investigation*, fifth report, by D. McAlpine (from the author and Director of Quarantine, Melbourne); *A critical revision of the Genus Eucalyptus*, by J. H. Maiden, parts 28 and 31; *A monograph of the Genus Brickellia*, by B. L. Robinson; *The Ohia Lehua Trees of Hawaii*, by J. F. Rock (2 copies); Hand book of the *Bryophyta of South Africa*, by T. R. Sim, parts 1 and 2; *Seeding and Planting*, by J. W. Toumey; and the *Sixteenth report of the Woburn Experimental Fruit Farm*, by the Duke of Bedford and Spencer U. Pickering.

To the collection of travels has been added E. S. Meany's work on Mount Rainier, which has been presented by Mr. Hervey Lindley, and amongst the periodical publications received are several parts of the *Annals of the South African Museum*, from the Trustees, and the *Bulletin de l'Institut-Oinoue*, Tokio, extra number, from Mr. Y. Oinoue.

Manuscripts received include a valuable collection of 49 letters from Dr. F. Welwitsch, the celebrated explorer of Angola, to the late Prof. Daniel Oliver, written, judging from those bearing dates, between Sept. 29, 1864, and Dec. 7, 1868, part of the period during which Welwitsch was resident in London. These letters have been presented by Prof. F. W. Oliver. A typed copy of *A List of Plants found in the District of Uitenhage... together with a description of some new species*, by C. F. Ecklon, published in the rare *South African Quarterly Journal*, vol. i. no. 4, pp. 358-380 (1830), has been received from Dr. Schönland. The cost of the preparation of this copy, which comprises 31 folio pages, was borne by Mr. F. H. Holland, of Port Elizabeth.

Additions to the Herbarium during 1917.—During the year about 6000 specimens were received as donations or exchanges, 1559 were purchased and 888 were received on loan. The principal collections are enumerated below:—

Europe.—*Purchased*: Dr. J. W. Ellis, Drawings of British Fungi; H. Sudre, Herbarium Hierasorum, fasc. 7.

North Africa.—*Presented*: Egypt (F. G. Walsingham) by the Ministry of Agriculture, Cairo; Sollum, by Capt. K. B. Williamson.

China.—*Presented*: China (G. Forrest and F. K. Ward), by the Royal Botanic Garden, Edinburgh; China and Japan (E. H. Wilson), by Prof. C. S. Sargent.

India.—*Presented:* Madras, by the Madras Government Herbarium through Mr. J. S. Gamble; Malay Peninsula, by Mr. I. H. Burkill, and the Federated Malay States Government through Mr. C. Boden Kloss.

Malaya.—*Presented:* Siam, by Phra Vanpruk, Khun Winit Wanadorn, and the Federated Malay States Government through Mr. C. Boden Kloss.

Australia.—*Presented:* Eucalypti and Acacias, by the Director of the Botanic Gardens, Sydney; Mosses by Mr. W. Greenwood; Bellenden Ker Range, by Miss L. S. Gibbs.

Tropical Africa.—*Presented:* Uganda, by Mr. J. D. Snowden; Katanga, by Mr. A. Ringoet; Southern Rhodesia (J. A. S. Walters), by the Department of Agriculture, Rhodesia, and Mr. F. Eyles; Rhodesia, (A. J. Teague) by the Bolus Herbarium.

Purchased: Rev. F. A. Rogers, Rhodesia and the Belgian Congo; R. A. Dummer, Uganda.

South Africa.—*Presented:* Mosses and lichens, by the South African Museum.

North America.—*Presented:* British Columbia, by Miss E. M. Warren; United States (H. Eggert and others), by the Missouri Botanical Garden.

Central America.—*Presented:* Mexico (Frères G. Arsène and Nicolas), by Prince R. Bonaparte.

South America.—*Presented:* Colombia, by Mr. M. T. Dawe; British Guiana, by Mr. A. Leechman; Peru (Sr. N. E. Esposto), by Prof. Jules Gaudron.

Plants have been received from Mr. W. B. Turrill, Assistant in the Herbarium, who has collected them while on active service. The Chinese plants collected by Messrs. Forrest and Ward contain interesting specimens of Rhododendrons. The specimens received from the Federated Malay States Government contained plants collected in the Langkawi and Telebin Islands by Mr. C. Boden Kloss. Mr. J. M. Black has presented specimens of new species of Australian plants described by him in the *Transactions of the Royal Society of South Australia.* Miss L. S. Gibbs has given specimens collected by her in the Bellenden Ker Range. Some of Mr. J. D. Snowden's plants came from Mt. Elgon. An interesting collection from Katanga containing many plants of economic interest has been received from Mr. A. Ringoet. Miss E. M. Warren has sent additional specimens from the Kootenay region of British Columbia. Mr. M. T. Dawe's Colombian collections have been made along the Rio Magdalena, Santa Marta, Cartagena and the Goajira Peninsula. Prof. W. Bateson has presented South American Calceolarias and hybrids produced from them. Two important sets of drawings have been received: one of British Fungi from the collection of the late Dr. J. W. Ellis (See *K.B.* 1917, 87); the other of Orchids drawn by Mrs. Janet Ross and presented by the Bentham Trustees (See *K.B.* 1917, 85).

Hippocratea Cumingii and H. Maingayi.—An enquiry as to the original specimen of *Hippocratea Cumingii* reveals an amount of confusion that can only be dealt with in a short note. *Hippocratea Cumingii*, Laws., was described in 1875, being based upon flowering specimens collected in Malacca by Griffith, and in the Philippines by Cuming (no. 1725), the specific name being derived from the latter. Sir George King afterwards enumerated it as an imperfectly known species. It proves on comparison to be identical with the earlier *H. macrantha*, Korth., based upon a specimen collected at Banjermassing, Borneo. The latter name was unfortunately transferred by Sir George King to another plant, with the remark, "flowers of Chittagong and Assam specimens of this which I have dissected agree perfectly with Korthals' figure." This figure, however, shows villous petals, and the other characters are also not in agreement. He also cites as synonymous, *H. lanceolata*, Ham., *H. grandiflora*, Wall., and *H. obtusifolia*, Laws. (in part, not of Roxburgh), with the additional localities, Sikkim, Burma, South Andaman and Perak. These, unfortunately, do not represent the plant of Korthals, and, further, the Perak plant is distinct from the others cited, and has been described under the name of *H. nigricaulis*, Ridl. It also includes a specimen from Malacca, Griffith, which is written up as *H. obtusifolia*, Roxb., though not cited by Lawson, so that it is uncertain whether he intended to include it. There is also the difficulty that both Wallich and Lawson included under *H. obtusifolia*, Roxb., materials which do not belong to it, as pointed out by Sir George King. This point, however, has not yet been fully cleared up. The Perak specimen just mentioned, however, belongs to *H. nigricaulis*, Ridl. The synonomy and distribution are as follows:—

H. macrantha, *Korth.* in Temminck, Verh. Nat. Gesch. (1839-42), p. 187, t. 39 (non King). *H. Cumingii*, Laws. in Hook. f. Fl. Brit. Ind. i. p. 624 (1875).—Ceylon, *Walker*; Malay Peninsula: Malacca, *Griffith*; Kew Distrib. 906; Johore, *Ridley* 4183, 11139, 13446; Borneo: Banjermassing, *Korthals*; Kuching, *Haviland* 2859; Kulong, *Haviland* 2876; Sarawak, *Beccari* 4063; Philippines: Island of Samar, *Cuming* 1725.

H. nigricaulis, *Ridl.* ined., *H. macrantha*, King, Mat. Fl. Malay Penins. i. (1896) p. 643, in part, (excl. syn.; non Korth.).—Malay Peninsula: Malacca, *Griffith*; Perak, *King's Collector* 5118, 7570, *Wray* 631; *Scortechini* 1047.

The two plants are readily distinguished. *H. macrantha* has distinctly acuminate leaves, and petals densely glandular-villous on the inner surface, while *H. nigricaulis* has obtuse, or very shortly and abruptly acuminate leaves, and the petals are glabrous.

Hippocratea Maingayi, Laws., was based on a fruiting specimen collected at Malacca by Maingay, with the distribution "? Borneo", the source of which is Sarawak, Beccari, no. 3005. Both, however belong to *Lophopetalum reflexum*, Laws., which

is based on a flowering specimen from Malacca, Maingay. The synonymy and distribution are as follows:—

Lophopetalum reflexum, *Laws.*, in Fl. Brit. Ind. i. p. 616 (1875), King, Mat. Fl. Malay Penins. i. p. 638. *Hippocratea Maingayi*, Laws. in Hook. f. Fl. Brit. Ind. i. p. 625 (1875).—Malay Peninsula, *Maingay*, Kew Distrib. 393/2, 397; Penang, *Curtis* 1502, 3607; Borneo: Sarawak, *Beccari* 3005. R. A. R.

Strychnos angustiflora.—The button-like seeds of this Hongkong *Strychnos* are so similar in their general appearance to those of *S. Nux-vomica* that it seemed desirable to have them analysed. Mr. Tutcher, Superintendent, Botanical and Forestry Department, Hongkong, to whom we are indebted for a supply of seeds, also informed us that he had recently received an application from a Chinaman to cut down all *S. angustiflora* plants growing near his house as the fruits dropped into a stream from which he obtained his water supply and poisoned the water.

Prof. Greenish, who has kindly examined the seeds at the laboratories of the Pharmaceutical Society informs us that working by the Pharmacopœia method the residue which would contain all the strychnine and brucine amounted to only 0·028 per cent. and gave only a slight reaction for alkaloid. No trace of strychnine or brucine is present in seeds.

The poisonous property alleged to be present in the plants growing in Hongkong may therefore reside in the fruit or the assertion may prove to be unfounded.